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COMMAND CENTER DESIGN HANDBOOK

Volumes 1, 2, and 3

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The CCDH consists of three volumes. Volume 1 addresses the planning and implementation of command center projects. It describes the process of conducting a command center upgrade in accordance with current Joint Staff Policy, and provides a practical interpretation of this guidance and examples of different approaches to the task. It includes an annotated bibliography and examples of command center projects that provide useful information to planners engaged in projects of any size or scope. Volume 2, Command Center Spaces, provides an integrated view of command centers on space-by-space basis. Thirty-eight spaces that might be included in command centers are defined in term of the tasks they support. Staffing, activities, equipment, and other operational characteristics are listed, and the impact of these characteristics on the design of the space is discussed. Volume 3 looks at the technology that command centers are designed to support. A command center is a system in which four subsystems interoperate-communications, information processing, briefing and display, and facilities. Volume 3 devotes a section to each subsystem, and discusses the standards, technological capabilities and constraints, and equipment options available. This volume is a dynamic reference to emerging technologies to be implemented in command center upgrades or development.

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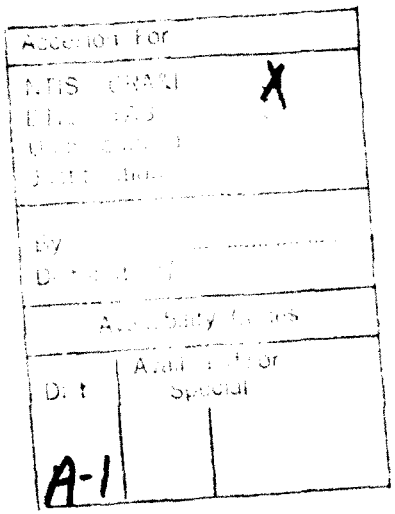
COMMAND CENTER DESIGN HANDBOOK

Volumes 1, 2, and 3

30 September 1991

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FOREWORD

INTRODUCTION TO THE COMMAND CENTER DESIGN HANDBOOK

PURPOSE

The *Command Center Design Handbook* (CCDH) was developed for use by command center personnel, principally those working in the command centers of the NMCS, unified and specified commands (including their component commands), and subunified commands. The CCDH essentially exists to help command center personnel maximize the usefulness and effectiveness of their systems and facilities. The guidance it provides is potentially applicable to other organizations and facilities. Readers in the drug enforcement and intelligence communities, for example, or those researching the broad topic of command and control, may find the CCDH a suitable reference.

SCOPE

The *Command Center Design Handbook* addresses the topic of command center improvement holistically and practically. The handbook contains detailed information about the hardware and software that operate in the modern command center. Throughout the document, consideration is also given to the personnel working in that environment, the procedures they employ, the facilities they occupy, and the information that gives purpose to command centers. Similarly, the CCDH offers guidance for both ideally funded and planned projects and situations in which resources, time, and options are limited. The CCDH offers a "real-world" interpretation of current command center initiatives and acquisition policies that will help the user comply with the requirements and obtain the best possible results from the process.

In addition to helping readers gain an understanding of the technologies and policies influencing command center initiatives, the CCDH can also help users select specific components that fulfill their needs. It is not a comprehensive catalog of all available products and programs; such a universal listing would be impractical to maintain and to use. Instead, the CCDH describes components that the Defense Information Systems Agency (DISA) has reviewed specifically for their applicability to command centers. These reviews, performed in response to CINC requests for assistance or in the context of DISA's Demonstration and Technology Survey (DTS) program, have been encapsulated and presented in the "yellow pages" sections of Volume 3. For this edition, limited product information was available, but as DISA conducts additional studies to assist the CINCs and continues the DTS program, the amount of product data provided in the CCDH will grow significantly.

CONTENT OVERVIEW

The CCDH consists of three volumes. In this edition, they are bound together under one cover, but each volume nonetheless has a distinct identity and purpose.

Volume 1 addresses the planning and implementation of command center projects. It describes the process of conducting a command center upgrade in accordance with current Joint Staff policy, and provides a practical interpretation of this guidance and examples of different approaches to the task. It includes an annotated bibliography and examples of command center projects that provide useful information to planners engaged in projects of any size or scope.

Volume 2, Command Center Spaces, provides an integrated view of command centers on a space-by-space basis. Thirty-eight spaces that might be included in command centers are defined in terms of the tasks they support. Staffing, activities, equipment, and other operational characteristics are listed, and the impact of these characteristics on the design of the space is discussed. A prototype space layout for each of the 38 areas is provided.

Volume 3 looks at the technology that command centers are designed to support. This volume reflects the concept of command centers that is expressed in the *Command Center System Architecture and TA/CE Guidance* document, which builds on the *Multicommand Required Operational Capability for Command Centers* (MROC 1-89). Under this concept, a command center is a system in which four subsystems interoperate – communications, information processing, briefing and display, and facilities. Volume 3 devotes a section to each subsystem, and discusses the standards, technological capabilities and constraints, and equipment options available. This volume is a dynamic reference to emerging technologies to be implemented in command center upgrades or development.

Each volume has a separate table of contents, list of figures, and set of "user aids." These aids include a list of references, list of acronyms, glossary, and index.

HOW TO USE THE CCDH

The CCDH is a large document treating many different topics. Its developers do not anticipate that every user will read it from cover to cover. All readers should become familiar with the general content by reading the introduction to each volume, and they acquaint themselves with the organization of the document and the user aids such as the indexes and topic headers on every page. With this basic knowledge, the casual user is equipped to pick up the CCDH when a question arises and readily find the section containing the needed information. Those readers wishing to read more of the text will benefit by comprehending all the ramifications of a problem and approaching a solution from several perspectives. For example, a user involved in equipping a briefing area could learn from Volume 1 in what order to approach the project and what sources to consult for information and assistance. Using Volume 3, the reader could research the state of the art in briefing and display components and determine what to look for and what to avoid. Finally, the reader could look to Volume 2 for guidance on incorporating these components in the briefing area and making the space suitable for its occupants.

EVOLUTION OF THE CCDH

To accomplish its intended purpose, the *Command Center Design Handbook* must be a "living document." While some of the more general guidance it contains will remain valid over time, technology and, to a lesser extent, Department of Defense (DoD) policies governing command centers undergo continual change. Input from users will also influence the format and content of the CCDH. The CCDH will respond to the changing environment and to the needs of the readership through a continuous maintenance and updating program.

A questionnaire bound at the back of this edition solicits comments from readers. These comments will be reflected in the next edition, scheduled for publication in March 1992. A yearly publication cycle, timed six months beyond the publication of each edition of the *Command Center System Architecture and TA/CE Guidance*, is anticipated, with supplements and change-pages to be distributed as needed throughout the year.

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Defense Information Systems Agency

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COMMAND CENTER DESIGN HANDBOOK

Volume 1:
Command Center Improvement Project
Planning and Implementation

PART 1. INTRODUCTION TO VOLUME 1: COMMAND CENTER IMPROVEMENT

ORGANIZATION OF VOLUME 1

This volume of the CCDH focuses on the management of command center initiatives. From its pages readers can gain an understanding of the process of defining, documenting, and securing approval for a project, both through adherence to formal policies and through practical advocacy and planning. The command center improvement process is described in detail in Part 2 of this volume. Part 3 consists of an annotated list of references that can help the reader develop the technical and managerial expertise needed to implement the process. Examples of the command center improvement process in action at various organizations are included in Part 4. (Additional examples will be available in subsequent editions of the CCDH as research and communication about these projects increases.)

THE NEED FOR COORDINATED IMPROVEMENT EFFORTS

The *Department of Defense Dictionary of Military and Associated Terms* defines a command center as "a facility from which a commander and his representatives direct operations and control forces. It is organized to gather, process, analyze, display, and disseminate planning and operational data and perform other related tasks."

In the U.S. military structure, command centers exist at three levels, which interrelate as parts of the Worldwide Military Command and Control System (WWMCCS). At the highest level, the National Military Command System (NMCS), which includes two fixed facilities, provides centrally controlled and survivable command capability to the national command authorities. The unified and specified (U&S) commands operate fixed command centers throughout the world to support their missions, which are either geographically or functionally defined. Below the level of the U&S commands are the component commands and subordinate unified commands, which provide specific kinds of support to the U&S commands.

Altogether, the "command center community" consists of approximately forty distinct organizations that must be capable of communicating and interacting effectively. In the past, command centers have been individually designed, built, and improved, based on each organization's unique activities and using whatever information on technology, equipment, and implementation practices was available to each one. While commands did find solutions to their problems under this methodology, their efforts constituted "reinventing the wheel" and applying resources over and over again to the same needs. Moreover, the design differences between one organization's independently developed solution and that of another organization prevented both personnel and equipment from working together efficiently. Over time, "lessons learned" in the command center environment have shown that focusing on the commonality among command centers rather than on their differences, and approaching the improvement of command centers in a coordinated way, can result in command centers that are more consistent, upgradeable, and, most important, interoperable.

MEETING THE CHALLENGE

The Command Center Improvement Program (CCIP), chartered in January 1984 as part of the Defense Communications Agency's Center for Command and Control, and Communications Systems, provided a number of opportunities to coordinate command center initiatives. Joint Staff approval of a landmark tool for integrating command centers, the *Multicommand Required Operational Capability for Command Centers* (MROC 1-89), was accomplished in April 1991. *[Note: Due to a 1991 reorganization, the renamed Command Center Initiatives Program is now part of the Joint Tactical Command, Control, and*

Communications Agency (JTC3A), which is subordinate to the Defense Information Systems Agency (DISA).]

MROC 1-89 recognizes that command center personnel perform similar tasks and require similar facilities and equipment. Central to all command center activities is the ability to communicate. Communication is vital to situation monitoring, information processing, and the dissemination of orders and control of forces. The MROC states that the independent and dissimilar development of command centers impairs communication and interoperability. On any level, individually engineered "stovepipe" solutions to each problem that arises in the command center result in a facility crowded with single-purpose devices, each one of which may have a different operating system, user interface, and set of connectivity requirements. The MROC calls for a unified effort to correct both the lack of interoperability among command centers and the lack of integration within them.

To address the deficiencies identified in the MROC, the *Command Center Architecture and TA/CE Guidance* was developed to provide a conceptual architecture that embraces all the equipment and facility components of the command center. It confronts the fact that certain capabilities are not yet technologically feasible, or products to support them are not fully developed or affordable. It accommodates this reality by defining both a target architecture, toward which command center upgrades should aim, and a current architecture, which identifies the options that are currently feasible and that offer the greatest potential for evolution to the target. This document also provides guidance for preparing a TA/CE, work breakdown structure, and other documentation required by the MROC-driven upgrade process.

The Joint Staff has indicated that projects in compliance with the MROC and command center system architecture will stand the best chance of receiving needed support. Command center planners derive a dual benefit from understanding and following the MROC process: not only will their projects be more likely to be approved, but, because critical interoperability and integration concerns are addressed in the MROC, the ultimate results will be better.

PART 2. THE COMMAND CENTER IMPROVEMENT PROCESS

INTRODUCTION

To carry out an enhancement to an existing command center, or to manage the development of a new facility, requires an awareness of all aspects of the command center improvement process. The person or group in charge of the upgrade must plan the project, secure funding for it and control the budget, and manage it as it progresses. This section provides a brief discussion of planning, management, and funding options. In addition, it includes a detailed examination of two formal approaches to managing command center upgrades.

PLANNING AND MANAGEMENT

The planning and management of a command center project requires awareness and fulfillment of two related yet distinct sets of tasks. On the one hand, the planner needs to focus on his or her organization and facility, pinpointing deficiencies and devising the best possible solutions to them; in this case, the planner's responsibility is to the end users in the organization who will be directly affected by the planner's achievement. On the other hand, the planner must understand and work within the DoD planning and procurement system. The planner must expand his or her focus beyond the needs of the local organization to include an awareness of political and economic trends, constraints, and opportunities that could have an impact on a project. From this perspective, the planner's responsibility is to fulfill all of the external requirements to document the project and secure approval for it.

These two paths share a single goal: the implementation of an effective solution to a deficiency within appropriate time and cost limitations. The steps in the paths are largely parallel, with each internal task, such as defining requirements, feeding into a product, such as a Requirements Submission (RS) or MROC annex, that is needed to support the project in the external world. The two paths are so interrelated that in practice they blend together, so that the planner intuitively balances the two perspectives and does not consider at any given moment whether he or she is fulfilling "internal" or "external" requirements. It is, however, possible and useful to examine the two processes separately.

The requirements for participation in the external (i.e., DoD) project planning and implementation process are detailed in a number of DoD documents, including Joint Staff SM 684-88. The internal steps in the life cycle of a project are less formally documented; they have been defined by experience and management principles.

Internal Project Management

The phases of managing a project from the internal, or local organization, perspective are:

- Needs and deficiencies identification
- Requirements development and initial program definition
- Detailed programming and requirements development/detailed acquisition and integration planning
- Coordinated program management
- Procurement, installation, and construction oversight
- Management of operation, maintenance, and training

Command center projects can vary in scope, from the procurement of a single piece of equipment or software to the construction, furnishing, and equipping of an entirely new room or building. Regardless of the size of the project, it is important that management of the project be approached systematically; however, variations in the length and formality of the process do occur.

Generally, very large projects, those being completed in a short span of time, and those relying on the cooperation of several different organizations will conduct the steps listed above in a very formalized manner. Alternatively, if a CINC expresses the need for a certain piece of equipment and directs his staff to bring it on line, in effect the first two steps of the process have already been completed. In another situation, an organization whose current processes and equipment are inadequate could request that a "tiger team" of technical experts analyze the deficiency and recommend a solution; this could take place in a few days. What is important is that all of these steps occur, in one form or another, and that their results contribute to the solution that is ultimately implemented in the command center. The steps are illustrated in Figure 2-1.

The **needs and deficiencies identification** phase is often the least formal part of the process. A need or deficiency can surface as the result of a substandard exercise result, a change in technology, a change in mission, new procedures, emerging threat information, or any of a number of other causative factors. Deliberate studies might also be conducted to evaluate operations and reveal potential problem areas. The emphasis in this phase is on defining the problem and communicating it to the appropriate command, Service, and Joint Staff authorities. Identifying products or solutions to the problem is not part of this phase and, if done too early, can jeopardize the project by locking in a solution before the problem is really understood.

Identification of a deficiency should include the origin and nature of the problem; the system, equipment, or space involved; the anticipated consequences of not resolving the problem; and, in the most general terms, possible alternative courses of action to eliminate the deficiency. This information can be recorded as a memorandum for record. As the process of presenting the deficiency to elements outside the organization begins, this information can be documented in the format required by the Service that is the organization's executive agent for the procurement.

The **requirements development and initial program definition** step begins the structured acquisition process. During this step project planners expand on the previously stated requirements, begin to identify a solution and develop a program to implement it, articulate a complete justification for the project, and estimate cost and time factors. A team may be assembled to work on the project. Depending on the scope of the project, the team can include project management personnel, end user representatives, and technical experts from within or outside the organization.

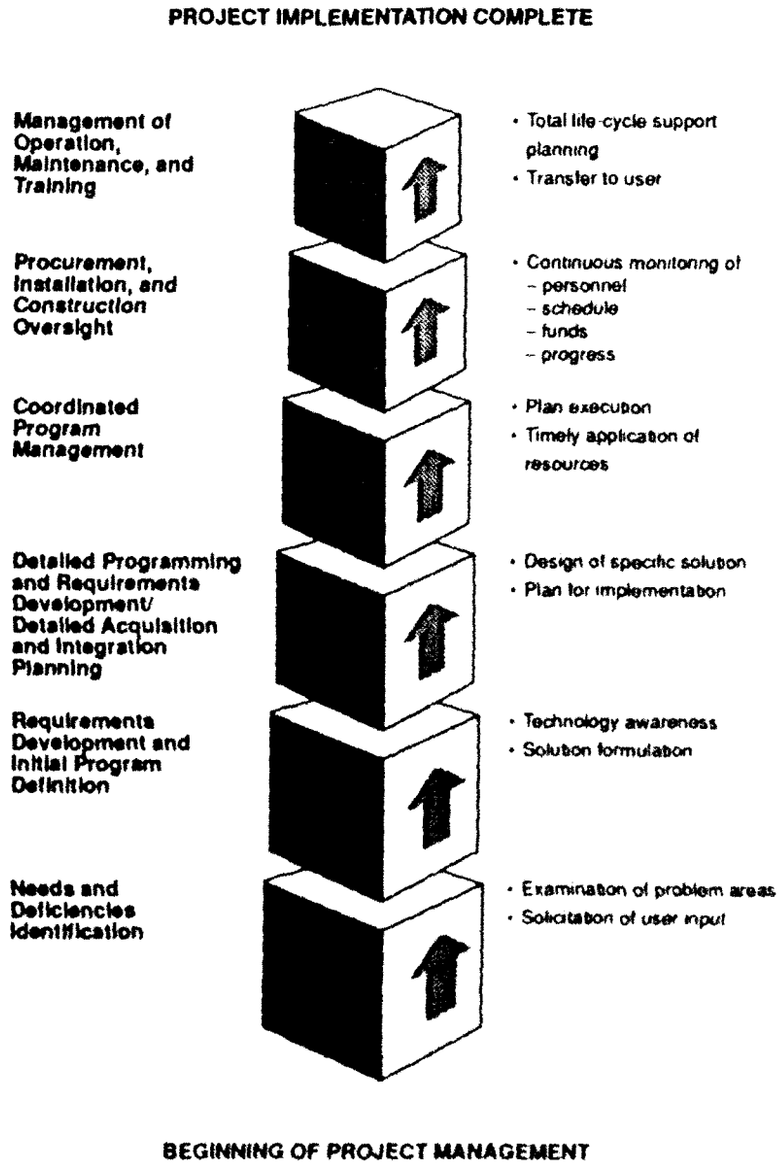


Figure 2-1. Internal Project Management Process

During this phase, the basic direction of the program is determined in working meetings of the team. Various methods of providing the required capability are proposed and evaluated. One of the main issues that is discussed is the impact the proposed change will have on the rest of the command center, including its physical plant, operations, equipment, and personnel. The result of this discussion may be an expansion of the program requirements to include additional or modified hardware, software, furnishings, or facilities elements such as lighting and power. Changes to the command center's organization or operational procedures may also be anticipated and subsequently instituted.

In addition to identifying what the improvement to the command center will consist of, the project team also must discuss how and when it will be realized. Because of funding constraints and delays in the availability of particular technologies, many command center projects are planned to be incremental or evolutionary. The principal challenges in these types of projects are to ensure that components installed today will not be made obsolete by the objective system that may be completed five years hence and, conversely, to ensure that new elements can be integrated smoothly into the existing system as they become available. As more and more organizations attempt to make wise short-term equipment investments while building toward a long-term objective system, the amount of support available to assist in the task is increasing. The command center system architecture provides a comprehensive plan for system evolution. Agencies such as the Multilevel Security Technology Insertion Program Office address the topic of incremental and evolutionary growth within a single technology area.

The work done by the project team in the requirements development and initial program definition phase to estimate the cost, scheduling, and scope of the project is reflected externally in the form of a Technical Assessment/Cost Estimate (TA/CE) or Preliminary Estimate (PE). An organization's executive agent for the procurement is usually responsible for preparing the TA/CE or PE, based on the informational groundwork prepared by the command.

Detailed programming and requirements development and **detailed acquisition and integration planning** occur in the next phase. This step involves the specific treatment of the requirements and the development of actual specifications for the project. As planning and development become more complex in this stage, awareness of the original requirements must be maintained to keep the project aligned with its original goals.

At this point in the process, the project manager focuses attention almost entirely on the internal aspects of the program, because the TA/CE or PE, which represents the major external reporting requirement, will have been completed in the previous phase. The project manager must still prepare formal documents, such as detailed system specifications, acquisition schedules, and configuration management plans, but they serve to organize the implementation of the project, not to secure approval for it.

Coordinated program management is difficult to define and yet absolutely essential to the success of a program. Not even the strongest justification for a project or the most urgent need for improvement can ensure program success if a project is not managed competently. Depending on the scope and duration of the project, program management can last days or years, and can involve supervision of the project team, equipment vendors, or contractors performing design, development, and systems integration tasks — or a mixture of personnel. Structured procedures, realistic schedules, and a complete documentation trail, particularly if the project is a long one and the staff involved might change in midstream, help to account for resources and ensure that all participants are working in concert.

In this phase, the project manager should look ahead to the installation and integration of new equipment. Ensuring a smooth cut-over from old equipment to new is a top-priority management task that requires substantial advance planning. The project manager should plan to have integration and testing performed in a separate facility, if possible, to prevent disruption of command center operations. For the same reason, the program manager might also plan to secure additional, non-operational equipment components for training purposes. To have these or other types of additional resources available when they are needed, the program manager will have to enforce strict adherence to the schedule or include a degree of flexibility in the arrangements by, for example, reserving extra space for longer than it will be needed.

Procurement, installation, and construction oversight is the phase in which plan becomes reality. The project manager's role emphasizes quality assurance: he or she must make sure that budget and scheduling requirements are met and that the results are satisfactory. In an austere funding environment, this role becomes crucial to the project's sustainability. To come this far in the cycle only to have the project fail or be terminated because of cost overruns, poor construction, or not-as-advertised operation of an installed system has a great impact on the command center. Not only are program dollars wasted, but time has elapsed during which a deficiency has persisted and perhaps grown worse. The users face a tremendous handicap in having to launch a new program to fulfill their requirements.

The project manager can do a number of things to monitor the program and reduce risk. There are a number of commercial management software products that are applicable to the scheduling and budgeting tasks the manager must perform. The manager might choose to establish periodic in-progress reviews to monitor the program and enable all the participants to communicate and resolve problems. Test plans help the manager keep track of the dates, results, and impacts of necessary tests and demonstration procedures. If the project features facility modification, construction, or software development, the manager should prepare to deal with engineering change proposals (ECPs). For each ECP, the change that is made should be recorded, along with the justification for the change; in addition, configuration control procedures should be applied to ensure that the impact of the change on other elements is anticipated and accommodated.

The **management of operation, maintenance, and training** phase in essence is the transfer of the completed project from the manager who brought it into being to the users it was designed to serve. A sound project is enhanced by well-conceived concepts of operation, training programs, and long-term maintenance plans. The success of a program is measured by how well it supports its intended users and by its reliability over time.

External Project Management

The Joint Staff has delineated responsibilities and procedures for identifying and satisfying command and control-related requirements in SM 684-88. Figure 2-2 depicts the process and indicates how the organization submitting the requirement, the Joint Staff, and other organizations interact. The following steps are referenced by number on the diagram.

1. Joint C3 requirements that are identified by a Service, DoD agency, or CINC are submitted to the Chairman of the Joint Chiefs of Staff as a Requirements Submission.

2. The RS is acknowledged by the Director, J-6, who provides review copies to CINCs, Services, other Joint Staff Directors, and defense agencies that request them. A 90-day validation period begins when the RS is acknowledged.

3. The Director, J-6, initiates a formal review leading to validation. This review ensures that applicable security and interoperability issues have been addressed.

4. The Chairman of the Joint Chiefs of Staff validates the requirement or returns it with comments to the originator. Validation certifies that a mission need exists, but Service resources cannot be committed without prior joint action.

5. Following validation, the Director, J-6, will initiate a joint action to task implementation of the course of action proposed in the validation. Depending on the selected course of action, a Required Operational Capability (ROC) or MROC may need to be developed, and plans for a PE or TA/CE will be initiated. A PE is prepared when the project uses nondevelopmental technology; a TA/CE is needed if special developmental activity is planned.

Traditionally, a ROC is the cornerstone of the process. The ROC is the formal request document on which senior authorities base approval decisions. It does not offer an answer to the problem, but, like the internal needs and deficiencies identification efforts that feed into the ROC, examines all aspects of the need. The ROC provides the following information:

- Statement of requirement: The statement of requirement offers background information relating to the identified need or required capability. It should include a brief history, organizational information, appropriate references, a discussion of the suggested approach to reach a solution, and other associated recommendations.
- Justification: The justification section defines and explains the required capability in terms of how it, or the lack of it, affects the assigned mission at the command center. It presents the required operational concept, sets forth the reasons why the command center is in need of this capability, and establishes the policy or mission basis for the request.
- Characteristics of the capability: This section describes, in as much detail as is possible at this early point in the process, the essential characteristics of the required capability. Ideally, the characteristics will be stated first in terms of the impact on the command center mission, with more detailed information to be added later relating to the specific capabilities of the required system, procedure, or facility.
- Associated considerations: The final section of the ROC addresses other considerations that might result from the implementation of the capability. In addition, the section could include guidance concerning scheduling, timing, budgeting, or other matters.

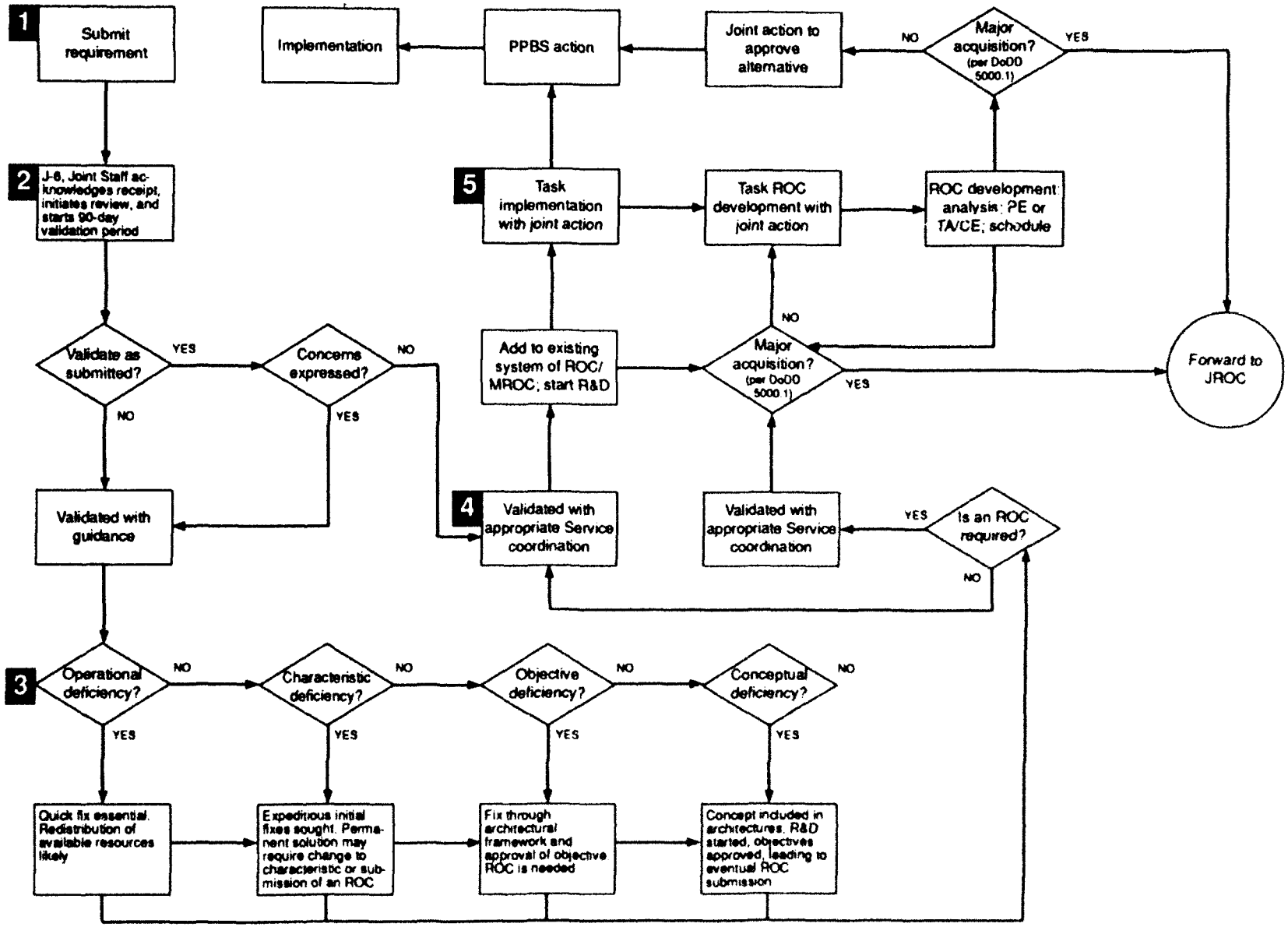


Figure 2-2. Traditional Process Mandated by SM 684-88

The MROC Process

The approval process governing enhancements to command and control facilities has been significantly simplified by the validation of the *Multicommand Required Operational Capability for Command Centers*. By defining deficiencies common to command centers and securing validation of an "umbrella" set of requirements, the MROC eliminates the need for command center planners to go through all of the steps listed above. Following the approval of the MROC, the Defense Information Systems Agency developed the *Command Center System Architecture and TA/CE Guidance*. These resources represent a streamlined, coordinated way for command center personnel to identify and document their needs and to implement forward-looking, interoperable solutions. Under this new process, a planner must:

- Review the MROC to become familiar with the common requirements identified for all command centers.
- Determine what subset of those common requirements exists in the planner's particular case and document that subset in an MROC annex. Any required capabilities that are not a part of the MROC also must be identified, along with a reason for deviation from the standard command center architecture.
- Develop proposed solutions using the command center system architecture. Specifically, the planner should ensure that the preferred solution is consistent with the target architecture, toward which command centers should evolve through iterative improvements. Even if technology identified in the target architecture cannot be fielded at the present time, it should be demonstrated that the alternative solution offers a path for migration toward the target standard.
- Prepare a TA/CE or PE for the project (or facilitate its preparation by the appropriate Service), using the TA/CE Guidance.

The MROC process is shown graphically in Figure 2-3.

Although the MROC itself focuses on common command center deficiencies and ways to standardize requirements, users can look to the MROC program for assistance in subsequent phases of project implementation, as well. As the MROC process is used and commands field solutions to the common requirements, "corporate knowledge" will be developed and shared about how certain components perform and how well these acquisitions fit in with the target command center architecture. Thus, through community

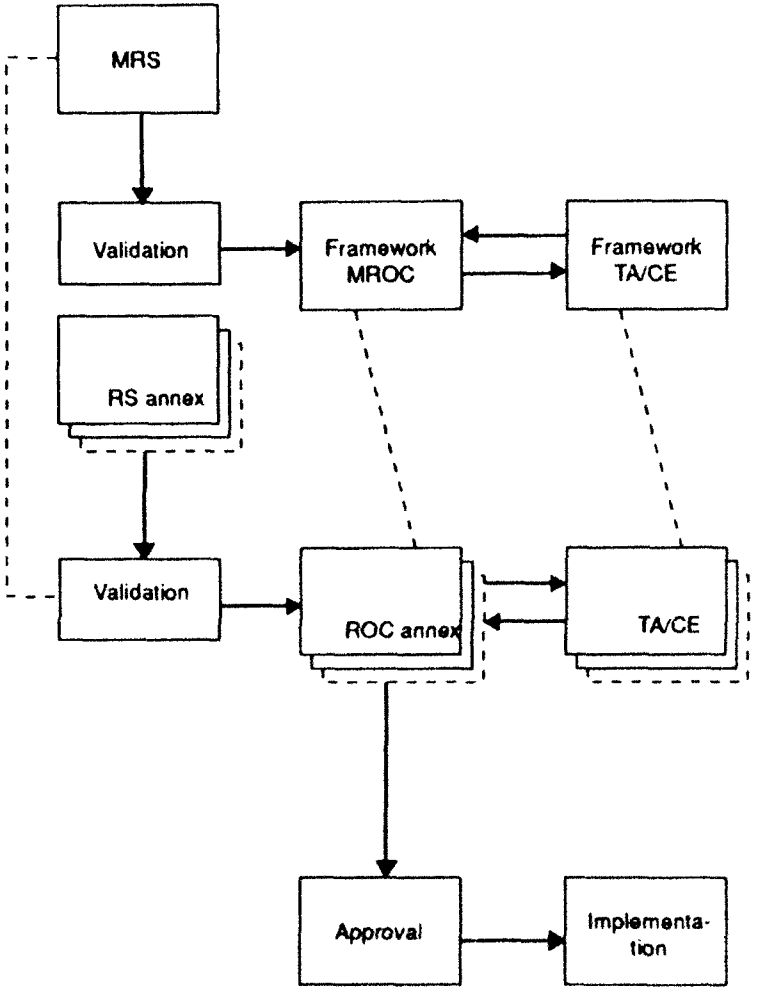


Figure 2-3. The MROC Process

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participation and communication, the MROC process will foster the identification of both common problems and common solutions.

The Project Manager's Role

While knowledge of these processes is vital, simply following them is not the "be all, end all" solution to managing a command center project. In the current austere funding environment, there is an underlying philosophical distinction between highly successful, dynamic programs and those that languish at every stage due to uncertainty, apathy, and "hot and cold" support from senior levels of command. The difference, in almost every case, is directly attributable to the project officer, who is responsible for making sure the project progresses along the paperwork and funding trail and makes it through all the milestones that lead to a fully supported, viable program.

A successful project is not the result of luck, but requires a knowledgeable, dynamic, enthusiastic individual who believes in the program and will fight for it until it is implemented and operational. Managing a C2 project requires a chameleon performance to acknowledge and integrate the many inputs, requirements, and concerns from all quarters. At times, the project officer will have to play the role of a dogmatic, unyielding despot, rolling over antagonists and forcing acceptance of "hard" requirements that are politically sensitive or essential to the core of the project. At other times, he or she will act in the role of a negotiator or peacemaker, molding alliances and creating compromises to resolve contentious issues.

Regardless of the role required, the project officer must be visible and vocal so that the project retains momentum and does not fall victim to the apathy that will place it at such a low priority that it is never funded. This philosophy must be embraced early in the formative stage of a project for it to have any hope of survival.

A reference tool such as the CCDH is valuable in that it describes a process and delineates the steps in that process, giving the reader the necessary knowledge to begin to manage a project, but it is helpful to balance such information with the understanding of how that information should be applied. The reader can develop intuition by talking with experienced project managers and by participating in the CCIP conference and similar information-exchange forums. The process examples in Part 4 of this volume can also help the reader discover why certain efforts succeed and others fail; they address a variety of projects from different perspectives and highlight the lessons to be learned from each one.

FUNDING AND BUDGET MANAGEMENT

In conjunction with the steps in the planning process, certain requirements must be met to secure funding for the project.

The Planning, Programming, and Budgeting System

Each Service implements its own Planning, Programming, and Budgeting System (PPBS), but all have the same basic characteristics. The PPBS is a continuous cycle that allows funding requirements to be articulated, developed, adjusted, and fulfilled over a three-year period. A planned overlap between the cycles exists; this allows emerging requirements to be factored into the system as quickly as possible, while still permitting more stable requirements to be planned for over the long term.

The phases of the Service-wide PPBS are:

- Comprehensive planning allows top-down guidance to be translated into meaningful plans and requirements. Streamlined planning documents and mission area analyses help set priorities among objectives and assess strategies in this phase.
- Programming, which is critically linked to planning, consists of development of the Service Program Objectives Memorandum (POM), the accomplishment of a formal program review, and approval by the Secretary of Defense. Initial program costing occurs during this phase.
- In the budgeting process, the costing of the Service program is refined, reviewed, and approved. The result becomes part of the President's budget.

Within this system, the CINCs have certain responsibilities. The involvement of the CINCs has increased in recent years, resulting in closer coordination among all levels and greater cooperation among the Services. The CINCs' responsibilities include:

- Submitting an Integrated Priority List (IPL) or equivalent list of each CINC's high-priority projects.
- Providing the Services information needed to determine and report in the POM the funding level for each IPL.
- When necessary, submitting issues for consideration during a program review if a CINC feels the funding level assigned in the Service POM is inappropriate.
- Reviewing the recommendations of their component commanders and integrating them into the CINC's plans and programs.

From the perspective of the project planner trying to obtain needed support for a project, it is crucial that the project be very well defined and explicitly linked to a documented deficiency or need within the command. Once the project has been adequately developed and documented, its placement on the IPL will depend on support gained during informal lobbying and formal meetings. It is important that the chain of command be adequately briefed about the project so that they are prepared to discuss and, if necessary, defend it in meetings.

Some organizations have recently begun to use decision analysis software tools to improve the prioritizing process. These tools apply weighted decision criteria to each project under scrutiny, in an attempt to ensure logical and consistent choices.

Guidelines and procedures more specific than those presented here are available from each Service. In addition, the DoD Directive 5000 series and introductory guides to the PPBS (both described in detail in Part 3 of this volume) provide additional information.

CINC Initiative Funds

Each CINC is assigned a certain level of discretionary resources in the Defense budget. The use of these funds is restricted — they may not be used for research and development or operations and maintenance — but within the limitations the CINC is permitted to use them as desired. Most often, CINC initiative funds are used for purchases of hardware and software to fulfill specific, immediate needs. CINC initiative funds provide an effective "gap-filling" mechanism that enables organizations to improve their day-to-day operation or solve definable problems of limited scope with an off-the-shelf product, without the need to enter the full PPBS cycle for that item.

AN APPROACH TO MAJOR CONSTRUCTION: THE FACILITY DELIVERY PROCESS

Introduction

The new construction of command center spaces and the large-scale renovation of existing facilities are challenging projects that require special planning and management approaches. The process involves early identification and documentation of needs and requirements followed by an extensive series of approvals at various levels, plus requests for additional information and justification. Finally, three to five years later, the physical facility is designed and constructed.

Because of the length of time required to complete the process, it can be anticipated that the personnel who initiate it will not be there during the design, construction, and occupancy of the command center. This situation often results in the loss or misinterpretation of critical facility requirements and criteria information.

The information and assistance in this section is intended to give the user the tools necessary to logically and methodically prepare a package of information that will remain consistent over the multi-year period. The information in this package should specifically state needs and requirements and should provide a "justifiable basis" directly related to the command center mission for each element of the project. While this information was developed to address complex, principally facilities-related efforts, the guidance it provides about preparing documentation, assembling a team, and scheduling project phases would be helpful for readers involved in smaller projects, as well.

The process developed in this section parallels the generic process described in the earlier pages of Part 2, but blends the discussion of "internal" functions (i.e., planning and activity at the local organization level) and "external" functions (i.e., reporting requirements or activities called for by the

Joint Staff or the Services) to depict an integrated approach. The information given in previous sections forms the foundation of the facility delivery approach; this section provides additional detail pertinent to the management of large-scale projects.

Process Overview

The facility delivery process is a highly complex, multi-year effort. It is intended to be a vehicle for achieving improvements to facilities (new construction or renovation) or equipment. The process is applicable to all major projects exceeding certain dollar limitations throughout the Department of Defense.

The process presented in this document is a generic compilation of the major events and activities present in the individual Service-specific processes. The sequence and the types of information required within the Service-specific processes should be quite similar to those presented herein.

The process is organized into five sequential phases:

- Needs and deficiencies identification
- Initial program definition and requirements development/ initial equipment requirements development
- Detailed facility programming and requirements development/ detailed equipment acquisition and integration
- Facility design and equipment development/coordinated program management
- Facility construction/equipment procurement/installation.

These phases occur in almost all command center enhancement projects; however, the facility delivery process suggests approaching and completing these phases in a highly structured, documented manner suitable for the magnitude of a major construction project.

A simplified version of the process is illustrated in Figure 2-4. It is set into motion by needs and requirements, which may be identified or generated from a variety of sources. Once started, the process requires information to be provided at various points. This information is the basis for the improvement effort. The information provided at these points is critical to the success of any project responding to an identified need or deficiency. One of the primary reasons for including this type of information within the CCDH is the firm belief that the personnel who staff the command center are an invaluable source of information which must be factored into any equipment or facility improvement effort.

Each phase in the process has points at which certain information, responses, or approvals are required. Figure 2-4 combines several types of information into a single diagram which helps explain the flow of information, participants in the process, products or documents produced, and sources of information and assistance.

Phase 1. Needs/Deficiency Identification

Objectives

The objective of this phase is to analyze and evaluate the current situation at the command center to determine whether the optimum operational environment exists in terms of command center operations and procedures, system and equipment support for operations, and physical facility support for operations.

This phase typically results in the identification of problem areas or deficiencies within the existing command center operation, equipment, systems, or facility. Once the areas needing improvement or modification are identified, possible solutions or alternatives can be evaluated and implemented.

Participants

Responsibility for carrying out the activities of this phase usually cannot be assigned to a single organizational element or even to a standard set of organizations. Because of the way the command center is structured, the required lines of communication, and the levels of command authority, deficiencies or problem areas may be identified at many levels and across a variety of systems. The individual user seated at a console can provide beneficial information, pinpointing a problem area relating to that specific task assignment. The command headquarters typically provides overall policy and procedural evaluation and problem identification.

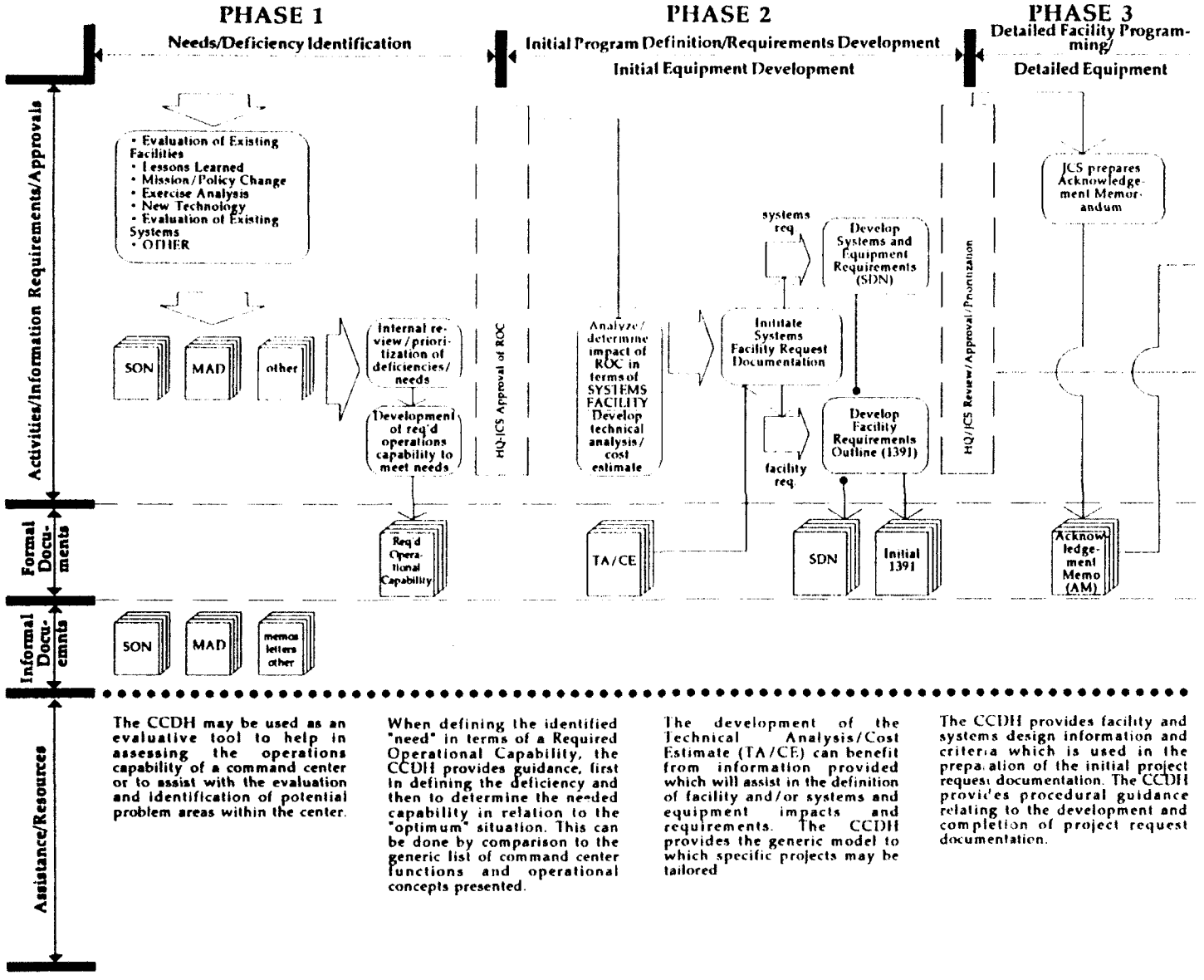
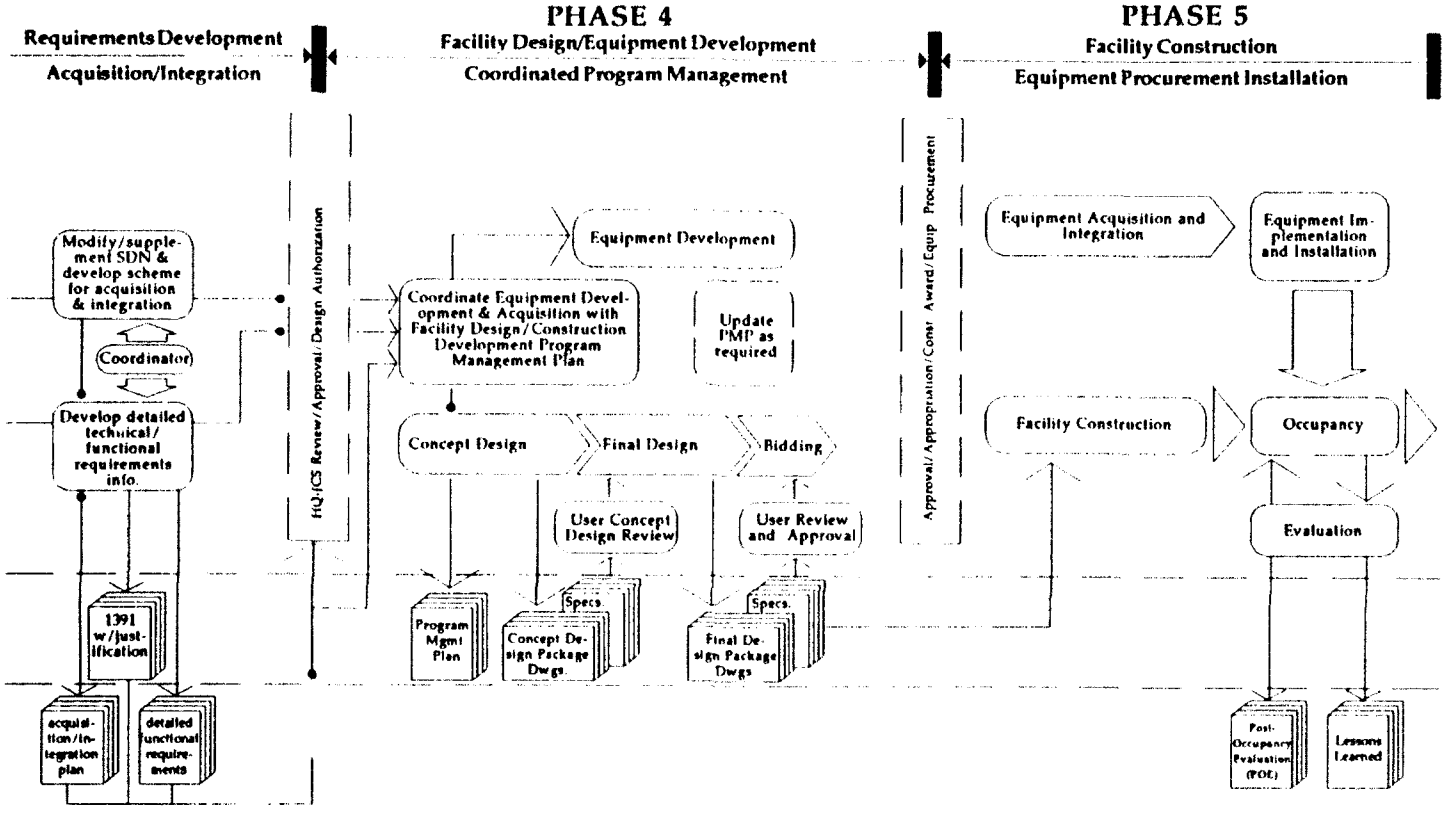


Figure 2-4. The Facility Delivery Process



The CCDH once again provides much of the detailed criteria and facility design information necessary in preparing the detailed project information (technical and functional requirements). Guidance outlining a comprehensive, methodical approach to the development of functional requirements and the 1391 is included.

Assistance will also be provided in terms of development of an integrated Program Management Plan which coordinates activities for both equipment development and acquisition and facility design and construction.

During Concept and Final Design, the CCDH provides the A/E with valuable reference information relating to command centers. It also provides the user-occupants of the center the training and methodology to comprehensively review the design at the concept and final stages, and provides worthwhile input prior to construction and occupancy.

Following construction and occupancy, the CCDH once again serves as an evaluative tool against which to measure the success of the improvement project or the adequacy of current operations. It is also the "lessons learned" from such evaluations which will be fed back into the CCDH for inclusion in subsequent variations for distribution.

Figure 2-4. The Facility Delivery Process (continued)

Essentially, the responsibility for the identification and development of needs or deficiency statements rests with all organizational elements and individuals working within the command center.

Guidance

There is a definite need for ongoing self-evaluation, analysis, and deficiency identification within the command center organization. Such a process will help to ensure that problems within a system or facility are not ignored and left to impede the efficiency of the command center operation during a crisis.

As stated earlier, the identification of deficiencies or needs is not the responsibility of any one person or organization within the command center. Everyone involved in the operation can offer valuable input or assistance in this task. There are several situations that might serve as catalysts to stimulate certain potential problem areas. These can include changes in mission, the results of exercises, and emerging technological capabilities. Organizations might also conduct evaluations of their facilities and operations to spot deficiencies and make improvements where possible. One method for doing so that is particularly appropriate when a facility redesign or other wide-ranging project is anticipated is the use of "activity logs" for comprehensive documentation and subsequent evaluation of operational activities.

The purpose of an activity log is to collect detailed task/activity information, along with listings of furnishings and equipment used during normal or crisis operations. This information is evaluated and used to identify needs or deficiencies, and later serves as the basis for requesting modifications to the existing systems, equipment, and facility, or for requesting additional or expanded operational capabilities.

The example in Figures 2-5 and 2-6 was developed and used to record and evaluate the operations of the Battle Staff Support Center (BSSC) and the Crisis Action Team (CAT) during a recent exercise at a specific command center. The basic format and organization of the forms is applicable to a wide range of uses at a command center. Modifications can be made depending upon the specific organizational activities present or on the information desired.

In addition to the activity log, a general comments form and a command center needs/deficiency identification statement can assist in reporting needs and deficiencies. Samples of these forms are included in Figures 2-7, 2-8, and 2-9.

Please complete an activity log sheet during each shift to record all of your activities and tasks. Activity information should be entered two or three times a shift so that you will be able to remember each activity and task. The time of day you choose to record your activities will depend on your individual activity level during that shift. At the top of each activity log sheet is a space to enter the date, your name, and your position or title. IT IS VERY IMPORTANT THAT YOU COMPLETE EVERY SECTION OF THE LOG SHEET!

- In the first column, write the letter code corresponding to the general activity in which you were engaged. (Refer to the sheet containing keys to each category.)
- The second column asks for the time of day in which you began the first activity.
- In the third column, labeled "TASK," please indicate the numbers corresponding to the individual tasks in which you engaged to accomplish the activity.
- The fourth column is for your estimate, in minutes, of the time it took you to complete each task.
- In the next column, please give the number of persons other than yourself with whom you engaged in the task. If you worked the task alone, the response would be "0."
- The sixth column, "PARTICIPANT'S TITLES," requests you indicate the titles of the other persons who participated in the task with you. If you performed the task alone, just write "N/A."
- In the seventh column, please indicate the three-letter code for the location of the task.
- Next, give the uppercase letter corresponding to any furniture or equipment you used and the lowercase letter representing the materials you worked with
- The final column, "COMMENTS," is provided for any comments you may have about your workstation or space and to specify any of the items you marked as "OTHER."

If the activity involved many tasks, you may not have enough space in the log to list them. If this is the case, please start another row, showing the same activity and start time to list the remaining activities.

Figure 2-5. Instructions for Completing Activity Log

ACTIVITY LOG

DATE: 12/0 NAME: LTC DAVID POSITION: JOC DIRECTOR

1 ACTIVITY	2 START TIME	3 TASK	4 TASK DURATN	5 # OF PERS	6 TITLE	7 LOC	8 FURN/ EQUIP	9 MAT	COMMENTS ABOUT WORKSPACE/OFFICE
A	0330	1 5 7	20	2	5 8	JOC	B P	D E F N	NEED TO GET OPLAN
I	0600	1 2 3 9 10 12	40	4	2 3 4 5	EAC ENT ADM AMH	B C E F L	A B C D E F L J	excess glare on terminal scrn conversations of others distracting
F	0640	1 2 3	50	2	3 4	JOC AMH	B 1 O	E	
A	0730	1 7 12	120	0	NA	JOC	B L P	D E F	
B	1000	3 7 10	90	0	NA	JOC	D	J	
K	1200	10	45	0	NA	OTH	A	NA	K out with OTH office
A	1300	1 7 14	30	1	2	SJT	C	E F	went to SIT rm for privacy

Figure 2-6. Sample Activity Log

INSTRUCTIONS FOR COMPLETING THE GENERAL COMMENTS FORM:

Each watch officer is requested to list general comments in order to:

- Identify shortcomings within the CAT/Battle Staff organizational structure.
- Improve communications flow within the Battle Staff.
- Identify information requirements needed by the command center to accomplish assigned missions.
- Identify areas in which command and control relationships with the JCS, other CINCs, and components could be improved.
- Document lessons learned for the benefit of future exercises and watch officers.

Figure 2-7. Instructions for Completing General Comments Form

THANK YOU FOR YOUR COOPERATION

ISSUE #	DATE/TIME (local)	GENERAL COMMENTS

Figure 2-8. General Comments Form

Command Center Needs/Deficiency Identification Statement

Name:_____ Date:_____

Organization:_____ Page___of___

1. Nature of Problem: _____

2. System/Equipment/Procedure Involved: _____

3. Potential Impact: _____

4. Suggestions/Solution: _____

Figure 2-9. Needs/Deficiencies Identification Form

Without exception, projects of the scope and size discussed in this section require a ROC. Completion and internal approval of the ROC typically end the needs/deficiency identification phase. The ROC is then forwarded to the appropriate headquarters agency for review and approval. It should be noted, however, that even after the ROC is placed in the process, the development of requirement characteristics should continue. This will help to ensure that:

- The ROC can be amended to note significant changes in requirements, technology, or philosophy.
- The requirements development portion of the overall process can be implemented without delay upon approval of the ROC.
- Any requests from the headquarters approval authorities for additional information or justification are accommodated efficiently by an existing organizational structure.

The efficient identification of needs or deficiencies within the command center marks a significant step toward the development and implementation of a mission-responsive solution. During this phase, it is important to maintain the process of needs or deficiency identification through the continuing support of all command center personnel, and to continue the development effort after the completion and transmittal of the ROC. In all documentation related to the project, simplicity and organization of the information contained within the identification statement are essential. Consistency in the formatting of the statement to allow for ease in evaluation and setting priorities is also essential.

Resources and Assistance

Part 3 of this document is a list of references that can assist planners with all aspects of command center project planning and implementation. Additional sources that are specifically pertinent to needs/deficiency identification include:

- JCS Pub 19 series: This series of volumes can offer assistance by providing the standard of operations at the command center from which the current operations may be evaluated or required operations described.
- DoD Directives 5000.1, 5000.2, 5000.3: These directives establish DoD policy and provide guidance concerning major systems acquisition procedures and the conduct of test and evaluation for new systems or the modification of existing systems.
- CCDH, Volume 2: This volume provides generic information for typical spaces within the command center. Each space is described as a "functional area" where specific mission functions can be effectively accomplished. All relevant information is contained on only eight pages. This format allows the project manager of an upgrade to remove the eight pages for a specific space and copy them for distribution to those involved in a particular function (J2 for Intel Watch, J3 for Ops Watch, etc.). This information can be used as a generic reference in performing evaluations of the spaces within a specific command center.
- Other documentation: Typically, the Joint Staff, the U&S commands and the Services have established unique policy and procedural documentation relating to their specific areas of responsibility and operational need.
- CCIP technical experts: The Command Center Initiatives Program can assemble a team of experts familiar with a wide variety of command center technologies. Such a team can assess areas for improvement and help a command determine what its critical needs are.

Phase 2. Initial Program Definition/Requirements Development

Objectives

The objective of the Program Definition/Requirements Development Phase is to expand upon the previously developed ROC and to further define the program and project requirements.

Participants

Major participants in this effort include those personnel at the command center who played a role in initiating the original ROC. They possess understand the need or deficiency which prompted the improvement effort. In addition, it might be beneficial to include other specialists or organizations at this point in the process. Those available at the installation may include ADP specialists, electronics specialists, audiovisual engineers, facility engineers, systems specialists, communications specialists, and fire marshals. Finally, depending upon the scope and complexity of the project and the desired operational capability, it might be necessary to contract with outside agencies

for assistance and coordination in the development of the program requirements, feasibility analyses, program schedules, and request documentation.

Guidance

Once the ROC is approved and received at the command center, it is the responsibility of the initiating organization or personnel to continue with the definition of the program and determination of requirements. To maintain continuity of the project's primary goals stated in the initial phase, an orderly procedure or series of steps should be developed to ensure a responsive solution. Such a procedure could include the following activities:

- Identify and select the program team
- Familiarize team members with the process and the project
- Refine and expand the ROC
- Determine the overall impact of implementation on the existing command center systems and facilities
- Prepare the TA/CE
- Prepare initial systems and project request documentation

The first order of business in this phase is the identification and selection of the project team. This is a group of personnel at the command center who will be responsible for the further development of the project requirements, cost estimates, and scheduling. Important criteria to consider in the selection of personnel are:

- Familiarity with command center operations.
- Balanced representation from all C2 areas.
- Participation in the previous effort to identify needs and deficiencies and in the preparation of the ROC.
- Anticipated length of tour remaining at the command center. It is important to maintain as much continuity as possible.
- Areas of expertise relating to the statement of required capability.

In addition to the personnel within the command center who offer the "user's" insight into the required capabilities, other specialists who might be available at the installation should be considered. The specialists typically available could offer expertise in such areas as:

- ADP equipment and operations
- Communications equipment and operations
- Audiovisual systems
- Facility engineering
- Electronics and electrical engineering
- Fire protection and life safety standards
- Security
- Intelligence.

Finally, it is suggested that the use of outside agencies or expert consultants be seriously considered at this point. If the project is of sufficient scope and complexity, the use of experts early in the process could prove very beneficial to the overall success of the project. Areas in which consultants can provide valuable input include:

- Systems and software research and development
- Equipment development
- Feasibility studies
- Facility utilization and programming
- Mechanical and electrical system development
- Interior space planning
- Communications equipment and operations.

Certain key factors should be included in the process of selecting a consultant. Some of the factors include:

- Reputation and experience of the person or firm
- Familiarity and past experience with the type of project
- Possession or availability of necessary security clearances
- Access to the latest state-of-the-art information, innovations, technology, or equipment

- Location and ease of access to the project site.

Once the team members have assembled, they must become familiar with the background or history of the situation which initially prompted the development of the ROC, while also studying the ROC itself. In order to do this, the coordinator must make copies of the ROC available to members of the team, or in cases in which portions of the ROC contain classified information, set up a place and schedule times for the members to study it. A specified time frame (approximately 1 to 2 weeks) might be established for familiarization prior to any team "working sessions" to ensure information retention and continuity.

The initial working session of the team should be concerned with further definition and refinement of the ROC. At this session, ideas and options can be discussed, capabilities further defined, schedules established, and specific work assigned to team members. The session, while a somewhat informal exchange of ideas and thoughts, should focus on and remain within the bounds of the initially defined ROC. The result of the session should be a coordinated plan to proceed with work assigned to each of the team members for further research.

One of the major efforts at this point, and also the focus of many of the work assignments, should be the identification and analysis of the impact of the required capability on the existing command center facility and mission support systems. This impact, while not always an obvious issue, can be defined through a process beginning with the ROC itself.

It first must be determined what the operational capability means in terms of the existing facility, operational structure, and current systems. Several issues can be examined more closely, including:

- Can existing systems be modified to allow for the new capability?
- Can existing equipment be used or will more be required?
- If more equipment is required, what quantity will be needed and where will it be housed?
- What is the impact on personnel requirements?
- Will the operational capability affect the organizational structure of the command center or the operational adjacencies of personnel?
- Will the operational capability be in consonance with higher directives and procedures?

The answers to these questions will provide the basis for further development of the operational capability and help to identify the impact in terms of:

- Systems software requirements
- Equipment requirements
- Facility requirements
- Organizational and operational requirements
- Procedural requirements.

The major product which results from this effort is the TA/CE. The TA/CE is essentially the first "cut" or initial statement of the systems and facility requirements necessary to satisfy the operational capabilities set forth in the ROC. The TA/CE begins to place the proposal or project in more "real" terms by discussing schedules, hardware, software, physical or facility modifications, and budget needs. The TA/CE, while taking a step from the conceptual, deals with these aspects in general terms. The requirements and designs are, at this point, representational examples and are not intended to provide the detailed specifications required for procurement of the improvement or upgrade.

The TA/CE also represents a major decision point (milestone 0) in the process to determine whether or not it is feasible to proceed with the project.

The final task to be accomplished during this phase concerns the preparation of the initial project request documentation. Once the TA/CE has been prepared, reviewed, and approved, the project proceeds to the next level in the delivery process. The TA/CE contains the types of information and analyses necessary to prepare the initial request documentation. The documentation will typically fall into the category of systems or hardware development requests, or the category of facility construction or modification requests, or both.

The most common scenario which occurs at this point in the process involves the request for the development of new software packages or pieces of communications, electronic, ADP, or audiovisual equipment. The development of this new system will typically result in the need to reconfigure the existing command center facility to accommodate the system itself, or a new operational or organizational structure to operate that system. The type of request documents appropriate for use at this point would be:

- Systems Development Notification (SDN) for systems development

- DD Form 1391 (initial) for facility improvement (typically for construction projects over $1 million).

A Systems Development Notification is the formal documentation required to notify the appropriate approval agencies of an improvement action. It allows for complementary planning by supporting activities and permits notification to the submitting Service or agency of any known conflicts or impact upon the planned proposal. The SDN may include Service or agency documentation or abstracts thereof.

The suggested SDN contents and format would typically include:

- References.
- Enclosures.
- Title: a brief descriptive title of the proposed improvement or change.
- Date: the date submitted.
- Abstract: a brief narrative (100 words or fewer) to provide an executive summary that can be included in the SDN project status report.
- Requirement description and justification: a description of the requirement with appropriate justification. The requirement should be related to specific mission responsibilities and functions. If applicable, any previously validated ROCs which the SDN will contribute to, or satisfy, should be identified.
- Proposed solution: A description of the proposed method of meeting the requirement by providing, at a minimum, the following information:
  - General: Data Processing Installation (DPI) number
  - Hardware: provide item numbers, contract model numbers, equipment descriptions, funding type, price, and maintenance costs
  - Software: indicate hardware or software tradeoffs and availability from commercial sources
  - Milestones and status of planning: provide the estimated time frame for the undertaking, dates and brief descriptions of significant milestones, and the present status of planning and approval by the user and the service or agency concerned. Specify any remaining required approvals. Describe the actions, decisions and information that are required from the Joint Staff or the technical support activities
  - Required resources: identify the source and amount of resources required, including funds, equipment in excess of that previously described, man-months of programming effort, construction, testing, and, if appropriate, life cycle costs for maintenance and carry-forward
  - Justification for waiver of standards.
- Impact statements: the expected impact of the proposed acquisition, development, change, or action upon each of the following areas:
  - Operational: the impact on the operational mission should the SDN not be approved., and a statement of how the mission requirements are presently being satisfied
  - Existing systems: the impact of existing systems on the users of those systems
  - Telecommunication: the impact on the telecommunication system considering the existing, planned, and programmed capabilities
  - Physical: a description of the adequacy of the environmental support, mechanical systems, floor space, cable distance, and electrical power for the proposed configuration
  - Security: a statement, transmitted as an enclosure to the SDN if classified, describing the impact of the proposed system development on physical, communications and emanations (TEMPEST), security, and a mode of operation (i.e. dedicated, system high, controlled, or multi-level).
- Technical and managerial points of contact.
- Configuration information: supplementary information as required for nonstandard equipment for which a technical evaluation is necessary.

A sample System Development Notification is included in the appendix at the end of this volume.

As discussed previously, in this phase the proposed solutions developed to meet the needs or capabilities identified within a ROC will frequently result in the development of a new or modified system and the acquisition of additional equipment. When this occurs, the impact on the physical facility must be addressed. Impact studies conducted during this phase should result in the identification of facility deficiencies. Facility deficiencies can essentially be corrected in either of two ways: by the construction of a new facility, or by renovation or modification of the existing facility.

Certain projects can be approved locally by the CINC or by higher authority, depending upon the estimated cost of the project. Typically, any project over $1,000,000 will require the submittal of a DD Form 1391 for approval and entry into the annual military construction (MILCON) project listing.

The initial DD Form 1391 is used for preliminary approval of project requests before submittal to the formal MILCON Requirements List. The information in the 1391 will include project name and location, cost estimates, and a description of proposed construction.

The preparation of an initial DD Form 1391 allows the project request to be entered into the MILCON Requirements List and allows the appropriate approval authorities to review all requests. During the review priorities are established and the project, if approved, is placed into the MILCON Requirements List.

Upon the completion of the development and preparation of the SDN and the 1391, the documents are forwarded to the next level or headquarters agency for approval and continuation in the process.

Resources and Assistance

The annotated reference list in Part 3 suggests resources pertinent to this topic. The *Command Center System Architecture and TA/CE Guidance* document is especially helpful for in developing a TA/CE. Additional sources or references that may assist in the task of the initial program definition and requirements development at the command centers include:

- JCS Pub 19 series: This series of volumes can offer assistance by providing the standard of operations at the command center from which the current operations may be evaluated or required operations described. It will also assist in the determination of impacts on the current operations and mission at the command center. The series also offers specific guidance concerning the development and completion of SDN documentation.
- DoD Directives 5000.1, 5000.2, 5000.3: These directives establish DoD policy and provide guidance concerning major systems acquisition procedures and the conduct of test and evaluation for new systems or the modification of existing systems.
- CCDH, Volume 2: This volume provides generic information for typical spaces within the command center. Each space is described as a "functional area" where specific mission functions can be effectively accomplished. All relevant information is contained on only eight pages. This format allows the project manager of an upgrade to remove the eight pages for a specific space and copy them for distribution to those involved in a particular function (J2 for Intel Watch, J3 for Ops Watch, etc.). This information can be used as a generic reference in developing requirements and initial specifications for command center spaces.
- Other documentation: Typically, the Joint Staff, the U&S commands and the Services have established unique policy and procedural documentation relating to their specific areas of responsibility and operational need.
- Miscellaneous documentation: Typically, each Service and command has established unique policy and procedural documentation relating to its area of responsibility and operational needs. In addition, each Service will usually have guidance documents that assist in the preparation of project request documentation.
- Previously prepared TA/CEs, form 1391s, and SDNs that could serve as examples.

Format of Required Documents

Formats for the SDN and DD Form 1391 are shown in Figures 2-10 and 2-11.

Phase 3. Detailed Facility Programming/ Requirements Development

Objectives

The third phase of the process consists of the development of definitive information relating to the acquisition and integration of command center mission support systems and the development of technical and functional requirements relating to the construction or modification of the command center facility.

MEMORANDUM FOR THE DIRECTOR FOR COMMAND, CONTROL, AND COMMUNICATIONS SYSTEMS ORGANIZATION OF THE JOINT CHIEFS OF STAFF

Subject: WWMCCS System Development Notification

1. Reference: JCS Pub 19, Volume I, Annex B.

2. Enclosures: None.

3. Title: System Change Proposal; Request for the Devlopment of a Timed Master Catalog Passwords Capability

4. Date: 30 June, 1980

5. Abstract: Expansion of time sharing workloads at certain sites requires that individual Time Sharing Subsystem (TSS) users have access to the computer during specified periods. A system accepting master dialog passwords during specified time periods as a module in General Comprehensive Operating System would provide this capability.

6. Requirement Description and Justification:
a. HQ MTMC needs to limit access of specified TSS users to certain hours of the day. We have more users than TSS lines and, therefore, must limit their ability to access the computer. The option to schedule the TSS workload would aid in optimizing of use or computer resources.
b. HQ MTMC concurrrently processes online systems, batch job streams, and time sharing activities. Expansion of time sharing workloads has resulted in degradation of online systems and of time sharing response times. If time sharing access could be controlled, time sharing workoalds could be scheduled and the use of computer resources could be optimized. Timed System Master Catalog passwords will provide this control. Timed passwords, like those currently provided for system files, would provide each user with a specified "window" for his workload and limit the number of time sharing spawned batch jobs passed to the system. Any WWMCCS site providing time sharing support to its users could make use of the requested modification.
c. Category: D.

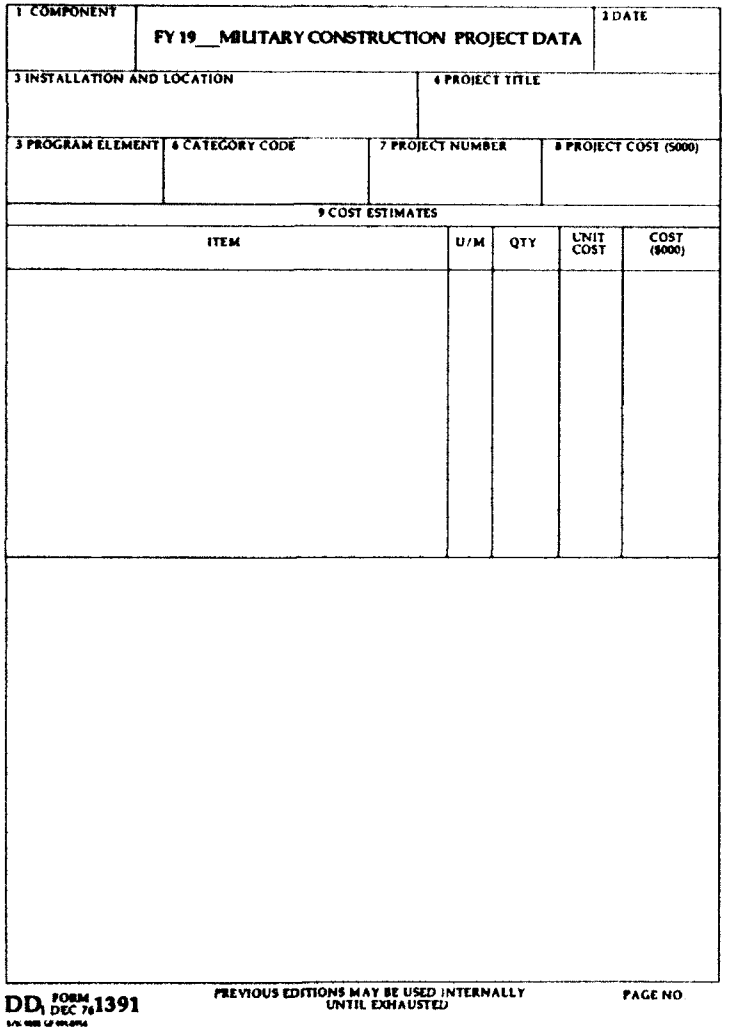
7. Proposed Solution: That the next WWMCCS Systems Release Software contain a module providing the above capability.
a. General: Data Processing Installation number associated with this requirement--DA 710304.
b. Hardware: WWMCCS Standard HIS 6000 system.
c. Software: WWMCCS Standard Systems Release W6.4.2.
d. Milestones and Status of Planning: Unknown.
e. Required Resources: Unknown.

8. Impact Statement: This software modification will provide a capability not presently found in WWMCCS software.
a. Operational: If this SDN is not developed and provided this site, serious TSS scheduling problems will occur, adversely affecting the efficiency of ADP operations. TSS scheduling is now being controlled by administrative procedures.
b. WWMCCS Standard System and Architecture: Impact on other users is estimated to be minimal.
c. Telecommunications: Not applicable.
d. Physical: Not applicable.
e. Security: This SDN will not adversely affect the security posture of the WWMCCS.

9. Technical and Managerial Points of Contact:
a. Major John B. Doe, USA
Plans and Technical Support Branch
Military Traffic Management Command
Bailey's Crossraods, Virginia 22041
Telephone: (703) 695-8889 AUTOVON: 225-8889
b. Technical--as above.
c. DRA/DDA: Military Traffic Management Command.

10 Configuration Information: Not required (SDN).

Figure 2-10. Systems Development Notification (Example)

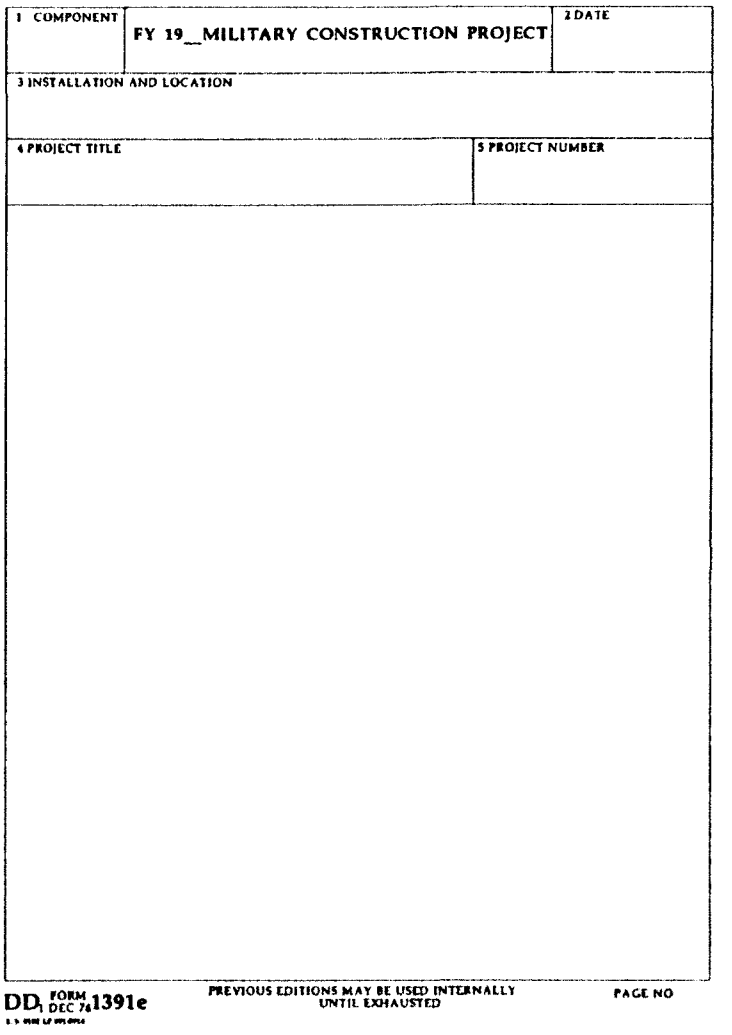


1 COMPONENT	FY 19__MILITARY CONSTRUCTION PROJECT DATA	2 DATE
3 INSTALLATION AND LOCATION	4 PROJECT TITLE	
5 PROGRAM ELEMENT	6 CATEGORY CODE	7 PROJECT NUMBER	8 PROJECT COST ($000)

9 COST ESTIMATES

ITEM	U/M	QTY	UNIT COST	COST ($000)

DD FORM 1 DEC 74 1391 PREVIOUS EDITIONS MAY BE USED INTERNALLY UNTIL EXHAUSTED PAGE NO



1 COMPONENT	FY 19__MILITARY CONSTRUCTION PROJECT	2 DATE
3 INSTALLATION AND LOCATION		
4 PROJECT TITLE	5 PROJECT NUMBER	

DD FORM 1 DEC 74 1391e PREVIOUS EDITIONS MAY BE USED INTERNALLY UNTIL EXHAUSTED PAGE NO

Figure 2-11. DD Form 1391

Participants

Participants in this phase will include the team members and, if possible, any appropriate consultants selected during the previous phase to assist in the development of the TA/CE, the SDN, and the 1391. The participation of these personnel will help to ensure continuity in the process and avoid lengthy familiarization delays. In addition, HVAC, mechanical, electrical, shielding, security, and other experts, typically available within the facility or installation engineering organization, should be brought into the project for assistance in developing the technical requirements information.

Guidance

Before the development of any detailed systems development or facility information, the command center must receive approval notifications relating to the formal request documentation submitted during the previous phase.

The response of the Systems Development Notification takes the form of an Acknowledgment Memorandum (AM). The AM is the vehicle by which the Joint Staff acknowledges receipt of the SDN and notifies other agencies that may be affected of a proposed acquisition, development or change, along with validating the initial requirement. Sometimes the AM will also identify the extent and level of any additional technical or administrative information that is required to ensure effective review and implementation. The AM is typically issued within 30 days following the completion of any necessary technical evaluation.

The following elements of information are normally reflected in the Acknowledgment Memorandum:

- Project number: A unique number assigned to the project that will serve as its means of identification throughout the project life.
- Background information: Identification of the title, organization, placement, and location of the system user.
- Proposed action: The purpose and scope of the proposed acquisition, development, or changes as reflected in the SDN.
- Participants: The identification of the principal participants in the action.
- Special considerations: Any policy, procedural considerations, or special factors that may have an impact on the proposed action, including compatibility requirements or other technical features that may be appropriate.
- Time phasing: List of significant dates and events associated with the proposal.
- Special information: The memorandum includes pertinent special information such as identification of number, type, frequency, and duration of additional on-site resources available to assist in the proposed action. It also identifies any known conflict or impact upon the planned proposal and includes a statement of any additional information requirements.

The Acknowledgment Memorandum may stipulate certain areas needing additional information or identify potential deficiencies in the proposal. If this situation exists, the SDN may require some modification or additional documentation. If approval is received, the project can continue on in the process.

The next important step in the process involves the close coordination of the systems and equipment development effort and the facility improvement effort. Careful coordination during this critical time will help ensure the success of the project. The facility modifications must be completed and functionally adequate prior to the introduction of new systems or equipment.

The development of an acquisition and integration plan will ensure this. This plan can be based upon an amplification of the information developed and used in the SDN. Additional information beyond that which was presented in the SDN would include:

- The development of a more definitive schedule showing dates, development projections, equipment deliveries, facility modification target dates, and other pertinent events
- An itemization, as best as can be determined, of the equipment requirements (type, number, size, etc.)
- The development of a comprehensive listing of equipment power and mechanical requirements
  - Power requirements
  - HVAC needs (cooling, ventilation, filtering, humidity)
  - Cable and duct accessibility needs
- The development of a list of potential spaces that will house the equipment
- A schedule that will identify the critical dates for the testing, evaluation, and operation of the system.

As indicated, the plan is the instrument by which essential coordination between system and equipment development and facility improvement efforts can be realized.

The acquisition and integration plan is an important step which should be completed prior to, or developed in conjunction with, the expanded versions of the facility request documentation required during this phase.

The facility request documentation which must be completed during this phase includes the expanded version of the DD Form 1391 and a compilation of detailed facility technical and functional requirements. This package forms the basis by which architects and engineers develop the design alternatives as solutions to identified facility deficiencies. The preparation of this information is critical to the success and responsiveness of the end product. The team, therefore, should be organized to draw on the expertise of each member to compile the most comprehensive package of requirements possible.

The first major effort in this undertaking involves the preparation of the facility functional requirements. Functional requirements are statements about what is needed in a facility to effectively support the activities, people, and equipment it will contain. These are usually qualitative statements supported by data about a facility's occupants, their mission, and their use of the building. The requirements do not describe the design solution.

Typically, two types of information are used: general and project-specific. General information is usually found in criteria and allowance documents prepared by the Corps of Engineers, Department of Defense and Headquarters agencies. The type of information included in the CCDH falls into the general information category. Specific information, on the other hand, is prepared for individual projects. The functional requirements are part of the project-specific information that presents the requirements of the facility user.

The functional requirements are frequently supported by requirements data. For example, the need for a shop area (requirement) is based on data such as the activities, the number of personnel, and types of equipment. Criteria are the standards or limiting values which will satisfy the requirements. For example, 50 to 100 footcandles of light (criterion) are needed if personnel have to read training manuals (requirement). Requirements and criteria are converted to a solution through design. The design solution can be evaluated by comparing it to the criteria and requirements to see if they have been satisfied.

A number of benefits can result from well-prepared functional requirements. Most important, functional requirements are needed so an effective solution for housing user operations can be achieved.

Other reasons that validate the need for the careful preparation of functional requirements information include:

- Faster design
- Fewer change orders
- Fewer delays due to lack of information
- The possibility of more efficient operations after moving in
- Fewer modifications after occupancy
- More accurate cost estimates.

The overall goal of functional requirements is to ensure that facilities effectively support the mission and operations of the occupants.

Research and prior experience have shown that future users of a facility know best how the day-to-day operations should run, and therefore must be involved in developing functional requirements. Building a facility to support these operations requires an understanding of the interface between the facility and the detailed operations. Users are better informed than anyone else about the activities, personnel, equipment, and time needed for operations.

To help prepare the functional requirements, a step-by-step procedure, along with forms for the entry of requirements information, has been developed. The procedure outlines a logical methodology for the user, who is typically untrained in the preparation of facility requirements.

As mentioned in descriptions of earlier phases of the process, team members should be selected based on their expertise, and the ability of each individual to contribute to the team effort. Consideration should be given to:

- Expertise of the member
- Availability of the member to devote an adequate amount of time to the effort
- The time remaining in the member's assignment
- The member's participation in similar efforts or in previous steps in this project.

In most cases, the members selected during the efforts to develop the ROC, the initial 1391, and the SDN should also be involved in the development of the functional requirements information and the detailed 1391. Once a team

has been assembled and new members familiarized with the project, the preparation of the functional requirements information may commence.

Forms have been developed to help the user prepare and present of functional requirements information. The 10 forms have been organized into five "information development" forms and five "information presentation" forms. The two types can be differentiated by the shape around the form number. Circles around the form number indicate forms used for the development of information, or basically "rough draft" forms. Squares indicate the presentation forms or those that will be submitted with the detailed facility request documentation package.

The example forms presented here and throughout the discussion of the functional requirements development methodology relate to two spaces within the command center core: the Battle Staff Support Center or CAT Area, and the Command Briefing Area. The examples will assist users in understanding both the form and its desired contents.

Requirements Information Development

Form 1, shown in Figure 2-12, looks at the factors involved in mission completion such as the overall function of a space and the operations that occur to support the mission. In addition to the function and operations information, there is also space for organizational identification as well as the notation of the point of contact (POC) responsible for the package development.

Form 2, the Activity Personnel Equipment Schedule (APES) shown in Figure 2-13, concentrates on the more detailed list of activities necessary to perform the previously identified function and operations of the space. Volume 2 of the CCDH will assist in the determination of this listing. The listing of activities will typically lead directly to an identification of the personnel and equipment required to complete them. When listing personnel, the user should consider the following factors:

- Number of personnel
- Rank, grade, and experience
- Position type (clerical, ADP operator, etc.)
- One shift or multiple shifts
- Supervisory or non-supervisory status.

Each of the various pieces of information listed above carries with it certain implications that may affect the development of design alternatives. It is

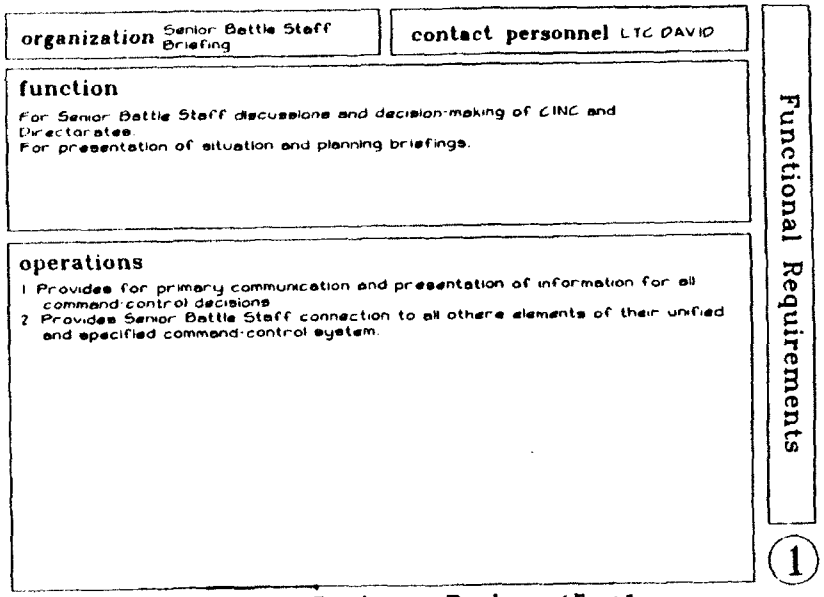


Figure 2-12. Requirements Development Form 1

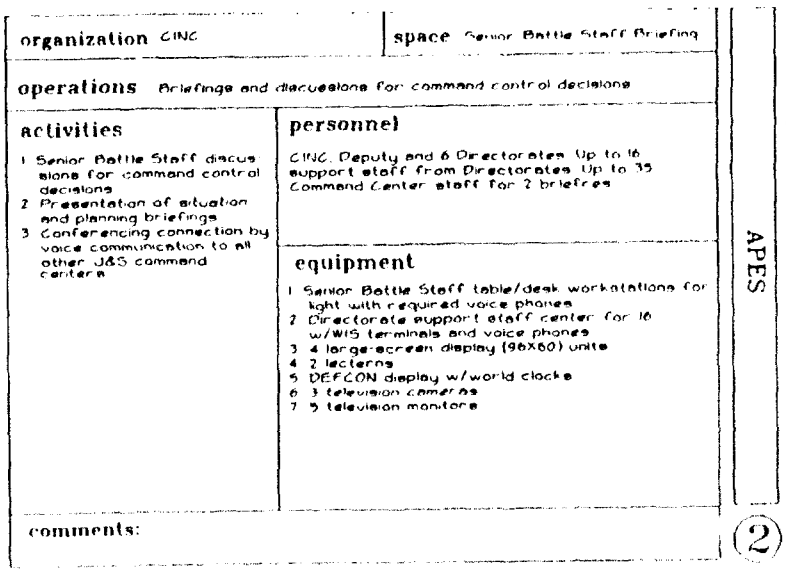


Figure 2-13. Requirements Development Form 2

important, therefore, to include as much information as possible when listing personnel requirements.

Equipment should be listed as specifically as possible. Some factors to consider in compiling the list include the name or description of the equipment, its size, and the quantity needed. This form also provides room to make general comments about the space or its requirements. Additional information relating to the required equipment is addressed in Form 3.

Form 3 in Figure 2-14 is an expanded version of the equipment list identified on Form 2. This form, however, includes more detailed information relating to the conditions that the equipment will generate within the space as well as the conditions that are required in the facility in order for the equipment to function properly. A source of information for assistance in the completion of this form is the previously completed TA/CE or the SDN, as well as the acquisition and integration plan.

Special care should be taken in the completion of this form, especially when documenting special power, air conditioning, or ventilation needs caused by some command center communication, computer, or electronic equipment. If assistance or additional expertise is required, the planner should consult with other members of the team or representatives of the facility or installation engineering services group.

Form 4 in Figure 2-15 begins to look at the physical needs or requirements of the space itself. This form documents the needs as identified by the end user of the space and assigns a weight or priority to the requirements. Establishing priorities in this way helps the designer to make correct decisions when making trade-offs between one need or another during the design process.

organization CINC — space Senior Battle Staff Briefing

equipment name	ape	conditions generated: noise	air cond	heat	other	explanation	conditions required: air cond	vent	light	elect	other	explanation
Conference Station	all					Tempest Security						
Support Station	all					Tempest Security						
Comm Support	all					Tempest Security						
Lg Screen Display	E			X								
R Screen Projector	E	X		X		Isolate Noise	X	X		X		Special Power
TV/Video Camera	E			X								
Lectern	E								X	X	X	Conn w/Comm
DEFCON Status Bd	all											

Equipment Data

3

operations CINC — space Senior Battle Staff Briefing

code	requirements	co	requirements
NI	1 Space for Senior Battle Staff to work together effectively at common desk/table		
NI	2 4 large-screen displays w/ several TV monitor units for briefings presented and controlled from lecterns		
NI	3 Security level for TS briefings plus an area for SI level interconnection to other command centers		
N2	4 Adjustable lighting to accommodate briefings conditions and prevent glare on WIS terminals		
NI	5 Sound system and room acoustical quality to allow for effective large group briefings and Battle Staff discussions		

needs codes
N - necessary (lack of seriously impairs function)
I - important (lack of impairs function)
H - helpful (lack of slightly impairs function)

purpose codes
1 - activity of function
2 - health or safety
3 - morale
4 - security
5 - equipment of performance
6 - other

Requirements

4

Figure 2-14. Requirements Development Form 3

Figure 2-15. Requirements Development Form 4

The ranking of requirements is done using a letter and number coding system. The letter indicates the reason the requirement is needed and the number indicates the purpose for the requirement. The system is as follows:

Need Codes:

N - Necessary: lack of capability seriously impairs function

I - Important: lack of capability impairs function

H - Helpful: lack of capability slightly impairs function

Purpose Codes:

1 - Activity or function

2 - Health or safety

3 - Morale

4 - Security

5 - Equipment performance

6 - Other

A code of N1 assigned to a requirement would indicate an important requirement that is necessary to carry out the activity or function within the space. A code of H3, on the other hand, would indicate a requirement that, if satisfied, would be helpful in reinforcing employee morale. The use of the codes, as mentioned earlier, helps determine which requirements are critical and must be incorporated into any successful solution.

The development and listing of the requirements statements themselves can be a very frustrating experience for personnel unfamiliar with the process. The most beneficial type of assistance that can be offered comes in two forms: a sample listing of requirements statements for similar space types, which can be found in the CCDH Volume 2, and a generic checklist of requirement categories, shown on the following pages. The combination of the two will help to ensure the development of a comprehensive requirements list.

Additional resources could include requirements identified in conjunction with the development of the TA/CE, the SDN, and the acquisition and implementation plan. While much of the material included in these documents focuses on the system requirements, it will sometimes lead directly to the identification of facility requirements.

Requirements Checklist

Requirements are statements about what is expected of a facility to support activities, equipment, or personnel. Requirements can be stated for an entire facility, for areas or space types, or for particular spaces or areas.

Requirements can be classified in many different ways; of course, categories always overlap to some extent. Requirements are quite varied for different kinds of spaces and activities. The list below is organized to help identify requirements that might be appropriate for particular spaces and their activities, equipment, and personnel. The list does not contain all possible requirements; others may have to be considered to suit particular applications.

Space

Requirements in this category have to do with size, dimensions, and shape of spaces:

- Critical dimensions, such as height, width, and length
- Square feet available
- Shape (rectangular, square, round)
- Clear span (minimum distance between columns or walls)
- Adaptability (the ability to change space easily if the need arises).

Access and Circulation

These requirements involve convenient movement of people or equipment within or into a space, control of such movement, or movement between spaces. Visual access (seeing in or out) is included, as well as:

- Privacy factors: sound control, visual control
- Size and type of openings (width, height, and type of doors; operability of windows, etc.)
- Control of openings (having a door, lock, etc.)
- Critical distance (horizontal, vertical) for cables, etc.
- Other functional relationships, such as access to a loading dock for forklifts, etc.

Utilities and Waste

These requirements are concerned with support systems that must be built into the facility. The type of system, the capacity or quantity to be handled by the system, limitations on its being shut down, tolerance or variance allowed, amounts of and locations for control, and other performance characteristics for the system must be identified.

- Electrical service
- Water (hot or cold)
- Sanitary sewer
- Special sewer or waste system
- Solid waste system
- Special gases or fluids (compressed air, medical gases, etc.).

Environmental Conditions

Requirements in this category include conditions necessary for human occupancy, performance and comfort, as well as for support of equipment. Again, quantities, capacities, controls, limits, critical locations and other data should be identified.

- Lighting: both general and task lighting
- Sound: controls, levels
- Thermal conditions: heating and cooling, temperature and humidity, air movement, and comfort ventilation
- Air quality: gases and particulates, dilution and exhaust ventilation, ventilation for hoods or booths
- Isolation and shielding from radiation, radio signals, etc.

Appearance/Finishes/Image

These requirements focus on the general character to be achieved (for image, safety, and morale of occupants), particularly for the surfaces. The requirements relate to characteristics or type of wall, floor or ceiling (static-free, washable, non-slip, color, wear and cleaning characteristics, loading or capacity), such as walls to accommodate charts or maps, or floors to accommodate forklifts.

Communication

This category of requirements identifies built-in communication features or components for which supporting wiring or equipment must be included in the design.

- Telephone terminals (detailed information is usually developed later in a special telephone survey)
- "Hot" lines
- RED/BLACK separation
- TV terminals or receptacles for monitors or cameras
- Patch panels/mux
- Fiber optic vs. twisted pair configurations
- Microphone and speaker systems.

Storage

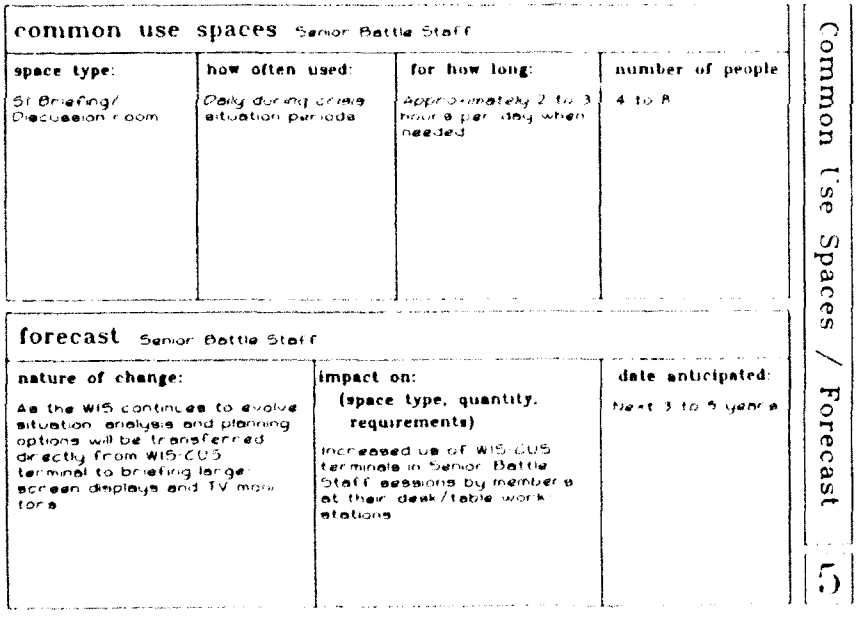
Built-in storage requirements can exist within a space or as a separate space. Requirements are easily handled in standard units of measurement. For shelving or parts bins, the total linear feet, height or number of tiers, and special shelf depth must be determined. Special treatment will be necessary for secure storage. For bulk storage areas, the floor area required, height limits, special dimensions, and cubic volume must be known to facilitate planning.

Special Building Features

This category includes all built-in features and components not previously covered, such as:

- Security features (vaults, safes, door locks, window bars, fireproof glass, special wall construction, heavy wire screens for parts storage, etc.)
- Health and safety features which are built in (eye-wash fountains, emergency chemical showers, non-skid surfaces, barrier guards, etc.)
- Fire suppression or warning systems
- Lifts, cranes, hoists, elevators, ramps, docks, etc.
- Vibration isolation
- Other items important for user satisfaction, morale, or performance.

The final requirements development form, shown in Figure 2-16, is the vehicle that determines two types of information. The first concerns the use of "common use" spaces. These spaces are those that, while not a part of the specific space for which the requirements are being developed, are needed by personnel to help in satisfying the functional or mission-related needs of the space. For example, an administrative office area may need the use of a conference room each morning for a daily briefing. The inclusion of this information helps in determining the location of the common-use spaces and the number and size of these spaces.



common use spaces Senior Battle Staff

space type:	how often used:	for how long:	number of people
SI Briefing/ Discussion room	Daily during crisis situation periods	Approximately 2 to 3 hours per day when needed	4 to 8

forecast Senior Battle Staff

nature of change:	impact on: (space type, quantity, requirements)	date anticipated:
As the WIS continues to evolve situation analysis and planning options will be transferred directly from WIS-CUS terminal to briefing large screen displays and TV monitors	Increased use of WIS CUS terminals in Senior Battle Staff sessions by members at their desk/table work stations	Next 3 to 5 years

Common Use Spaces / Forecast 1/2

Figure 2-16. Requirements Development Form 5

rev. Sept. '91

The other type of information relates to the anticipated needs of the organization and space. A forecast will identify possible changes and their impacts on current operation, staffing levels, or facility spaces. This information is typically more difficult to determine; however, the following factors may help in the forecast development:

- What has been the history of past changes?
- Are there new technologies currently under development which will decrease personnel or equipment and space requirements?
- Are there organizational or procedural matters currently being studied or modified that will affect the way the command center operates?
- Do changes occur on a cyclical basis that must be accounted for?

While there may be other factors to consider, these should help in beginning to look towards future as well as present requirements when developing the package of facility needs. Future requirements can usually be accommodated in a facility design solution, thereby reducing costs and minimizing impact when the changes are needed.

Following completion of the requirements development forms, the draft package should be circulated for review and comment by other team members and appropriate site command center personnel. It is important that the period for this review be limited to a reasonable amount of time (1 to 2 weeks) so the process can proceed without loss of continuity.

Presentation of Requirements Information

Upon the completion of the team review, a meeting should be held to determine the validity of the comments. Comments should be analyzed to determine whether they merit inclusion in the final functional requirements information package.

Preparation of the final 5 forms for the presentation of functional requirements information will be, in large part, a restatement or amplification of the information developed on the initial 5 forms. There is, however, some additional information that will be included.

Form 1 in Figure 2-17 attempts to graphically represent the layout or relationship of functions or activities within the space. The shapes used are very rough and are only meant to represent the general locations of activities or functions within a larger area. This graphic is not meant to be a design solution or floor plan that solves all of the identified requirements. The intent

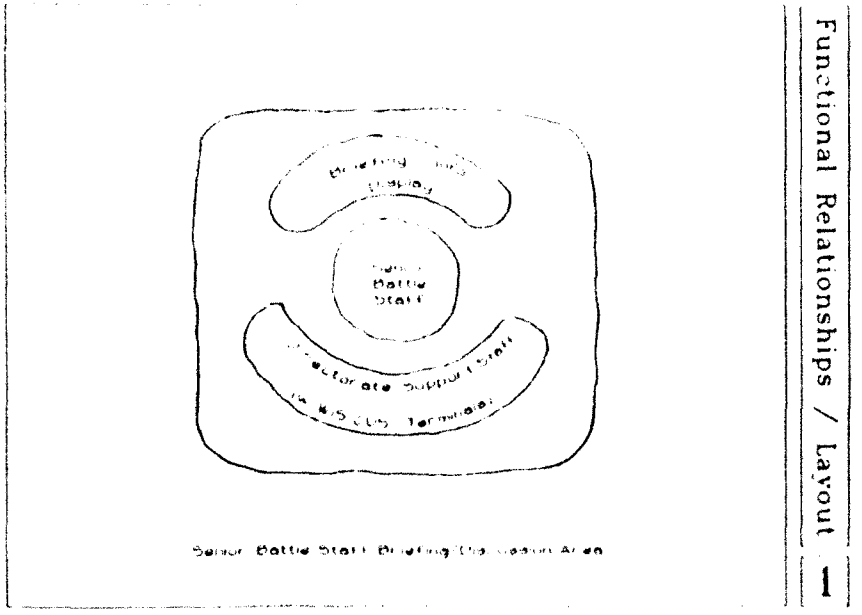


Figure 2-17. Requirements Presentation Form 1

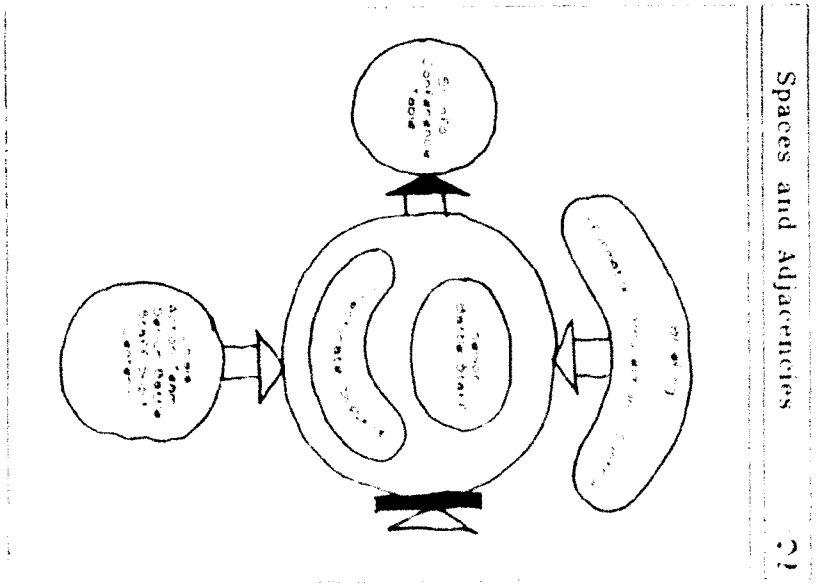


Figure 2-18. Requirements Presentation Form 2

is to communicate graphically the manner in which the space must function: the flow of information, the central focus within the space, adjacency of various activities, or isolation of others. It should be kept very loose and should indicate the optimum layout of activities and functions. Planners should try not to relate the diagram to the existing situation or facility.

Form 2 (Figure 2-18) also looks graphically at a space and its relationships. It focuses on the relationship of the project space with others surrounding it. The emphasis is to identify graphically the placement of the space in relationship to others in the command center. Preparation of the graphic should be given careful consideration because the ultimate layout and arrangement of spaces can either enhance or severely impair command center operations. Simple forms are used in developing the space and adjacency diagram. Circles represent the spaces, arrows indicate entrance points and numbered connections indicate the desired adjacency between each space. A legend of symbols (Figure 2-19) has been included for use in the preparation of the diagram. These symbols are only a suggestion of what could be used and are not meant to be the only acceptable way of presenting this information. Whatever graphic convention is used in presenting this information should be clearly defined and included with the diagram.

Form 3 in Figure 2-20 represents a summary of the functional requirements information for the space. The information here has been compiled from development forms 1, 3, and 4, with adjacency information included from presentation form 2. The requirements presented here should be organized by category, with the highest priority listed first. As a final check, it would be beneficial to review the requirements listed in the generic space in Volume 2 of the CCDH, as well as the generic requirements checklist mentioned in conjunction with development form 4.

Forms 4 and 5 (Figures 2-21 and 2-22) are essentially a restatement of the information on development forms 3 and 5 respectively. The only changes or modifications to the information presented here would be the incorporation of comments or suggestions resulting from the review and validation meeting.

The completed Functional Requirements Package is part of a larger document which includes the technical requirements for the proposed project. The content of the document is essentially the same across the Services with slight differences in the organizational format. The document is referred to as the Project Development Brochure in the Army, the Project Book in the Air Force, and the Facility Study in the Navy.

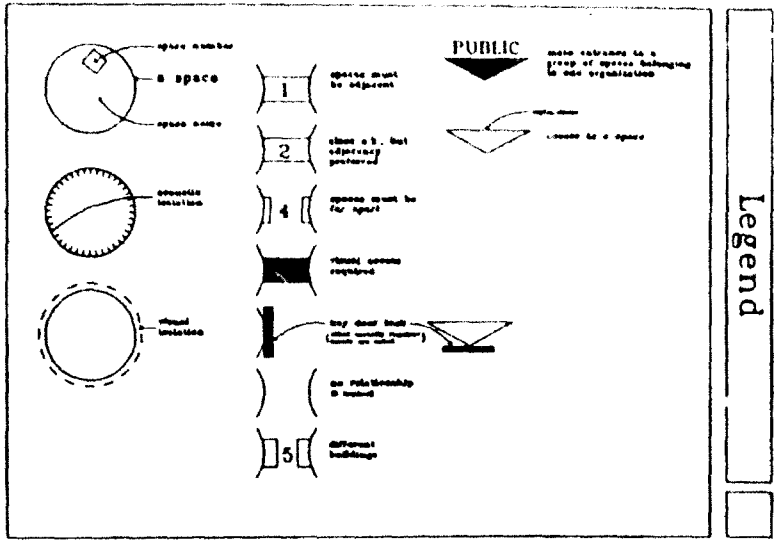


Figure 2-19. Symbology

square feet

2 000 to 2 200 sq ft

adjacent spaces

Primary - SI Briefing Room
Secondary - Battle Staff Support (CAT)

personnel

CINC
Deputy CINC
Up to 16 Directors
15-20 Support Staff
Up to 25 Command Center personnel
2 Briefers

requirements

1 Secure environment for sensitive briefings
2 Tempest and EMP/HEMP shielding
3 Large screen display system with 4 screens. Several TV monitor units to allow a clear view of information presentation to all assembled
4 Acoustical design to provide voice clarity and contentment of discussion within space
5 Fully adjustable lighting system to allow the reading of material during discussions without glare or distractions on VDT's and display screens
6 HVAC systems designed to provide optimal thermal comfort for room capacity
7 Fire protection/life safety requirements to meet applicable standards

Space Senior Battle Staff
organization CINC
Detailed Functional Requirements
3

Figure 2-20. Requirements Presentation Form 3

organization CINC — space Senior Battle Staff Briefing

equipment name	qty	conditions generated: power	air cond	heat	other	explanation	conditions required: air cond	heat	light	elect	other	explanation
Conference Station	all					Tempest Security						
Support Station	all					Tempest Security						
Comm Support	all					Tempest Security						
Lg Screen Display	1			X								
4' Screen Projector	1	X		X		Isolate noise	X	X		X		Special power
TV/video camera	1			X								
Lectern	1								X	X	X	Conn. w/comm
DEFCON status Bd	all											

Equipment Data
1

Figure 2-21. Requirements Presentation Form 4

common use spaces Senior Battle Staff

space type:	how often used:	for how long:	number of people
SI Briefing/ Discussion room	Daily during crisis situation periods	Approximately 2 to 3 hours per day when needed	4 to 8

forecast Senior Battle Staff

nature of change:	impact on: (space type, quantity, requirements)	date anticipated
As the WIS continues to evolve situation analysis and planning options will be transferred directly from WIS CUS terminals to briefing large screen displays and TV monitors	Increased use of WIS CUS terminals in Senior Battle Staff sessions by members at their desk/table work stations	Next 3 to 5 years

Common Use Spaces / Forecast
5

Figure 2-22. Requirements Presentation Form 5

The completion of the functional requirements is a major step in satisfying the documentation requirements of this phase. The remaining task involves the completion of the expanded DD Form 1391 (Military Construction Project Data). By this point, the majority of information required on this form will already have been developed. The TA/CE, SDN, AM, and the Functional Requirements Package provide the source for most of this information.

The DD Form 1391 requires specific information regarding the project. Although each project will have certain unique informational requirements, the following items are most commonly included in DD Form 1391 submissions:

- Blocks 1-8 include general or reference information needed to identify and track the project.
- Block 9 contains a general cost estimate for budgetary purposes, which is typically broken down into the following categories, and followed by the total amount requested for the project:
  - Electrical costs
  - Mechanical costs
  - Special construction costs
  - Design contingency
  - Cost escalation rate
  - Architectural costs (general construction)
  - Construction contingency
  - Supervision, inspection and overhead
- Block 10 is a description of the proposed construction. The description should include a discussion of what will be involved in the project in terms of demolition, construction, types of construction, communications, and utility support. Many times, additional information is included with regards to the initial requirements for the project and a discussion of the current situation. This information can be included in either block 10 or in a separately identified block 11.

Additional information to be provided with the DD Form 1391 could include such items as a location sketch, as shown in Figure 2-23.

Since the preparation of the DD Form 1391 carries such significance in the continuation and ultimate success of the project, the completed document

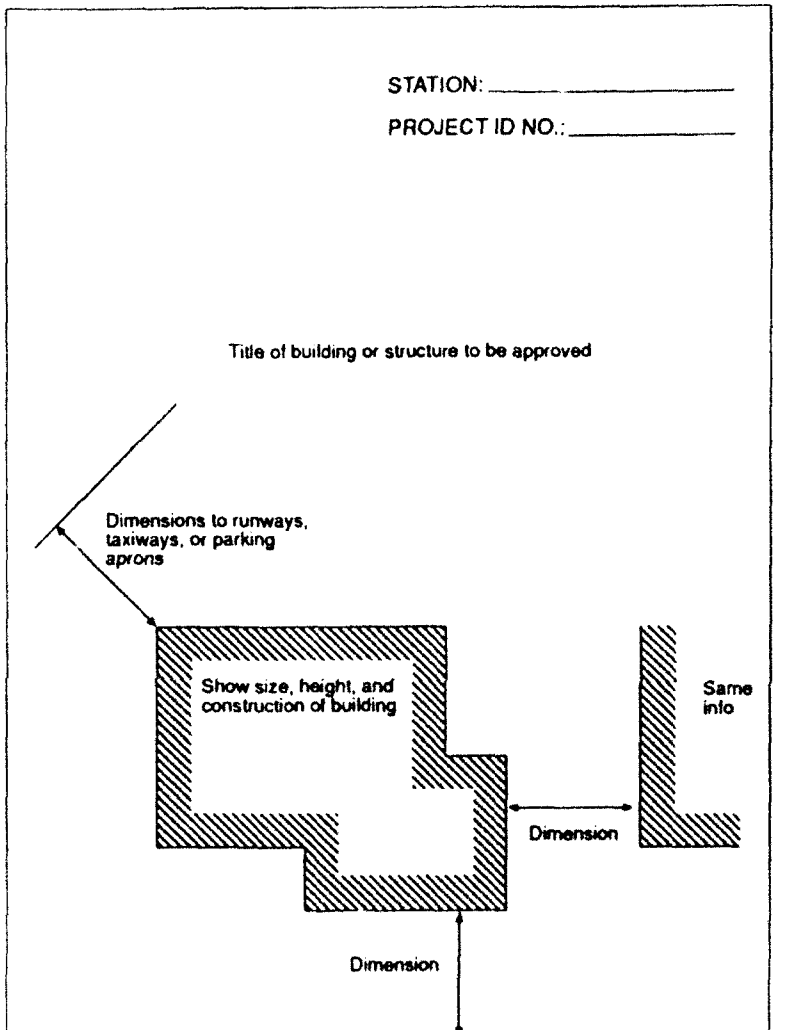


Figure 2-23. Sample Location Sketch

rev Sept '91

LINE ITEM_____

HEADING
1. Category Code as per instructions. _____
2. P or R number is correct. _____
3. Line item is properly titled. _____

DESCRIPTION
4. Proposed type of construction is most feasible for purpose and duration of requirement. _____
5. Standard design is not available, and special design is more feasible. _____
6. Descriptive figures are correct or properly explained. _____
7. Cooling system capacity and cost are reasonable relative to line item scope. _____
8. Scope is adequate for purpose. _____
9. Description is correct, complete, and concise for clear relation to items in the estimate. _____
10. Descriptive items have ample flexibility to permit minor changes. _____

COST ESTIMATES
11. Breakdown of items conforms in general with scope descriptive items. _____
12. *Cooling system cost is included in* primary facility unit cost. _____
13. Unit cost estimates are reasonable for the area. _____
14. Primary facility and supporting features cost items are correctly grouped. _____
15. Units of measure conform to Department of Navy Facility Category Codes, NAVFAC P-72. _____
16. All included cost items are eligible for MILCON funding. _____
17. Separate cost items are included to indicate items of unusual cost. _____
18. Computations are correct. _____
19. Total cost agrees with requested authorization and appropriation figures. _____

QUANTITATIVE DATA
20. Total requirement is compatible _____
21. Existing substandard and adequate entries are compatible with FPD. _____
22. Figure or funded, not in inventory, is correct. _____
23. Computations are correct. _____
24. Related items are germane to line items. _____

REQUIREMENT
25. Requirement is identified and established relative to its origin and importance to activity or naval objectives. _____
26. For new requirement:
    a. New mission or assignment is explained. _____
    b. Workload is equated and measured to the proposed facility. _____
    c. Other circumstances dictating requirement and Urgency are explained. _____
27. For expansion, improvement or replacement:
    a. Existing facilities are described and their deficiencies explained. _____
    b. Current and future workload is described in quantities or measures relative to existing and proposed facility capacity. _____
    c. Current and past arrangements to cope with deficiency are explained. _____
    d. Where applicable, comparative operating costs of existing and proposed facility are analyzed. _____
28. Efforts to solve the requirement by alternative methods are analyzed with rationale of proposed solution. _____
29. Effects of proposed facility on important programs and objective is explained. _____
30. Where applicable, status of line item relative to past and future increments, or other related line items is explained. _____
31. All such references as increasing requirements, assignments, workloads, expansions, new operations, deficiencies, high maintenance, savings, etc. are clearly explained in measurable terms or factors. _____
32. The requirement statement is clear, concise, informative, factual, and of such quality as to give a clear picture to an uninformed reviewer of the actual activity problems and how they were generated, and clearly establish the proposed facility as the most feasible solution and/or sound investment. _____

Figure 2-24. Check-off List for Review of DD Form 1391

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should contain only the best information. Some helpful points to consider in the preparation of the DD Form 1391 are:

- Since a maximum of 17 lines is allowed in block 9, the need for brevity is apparent. The first line should read the same as the project title as shown in block 4.
- Complete only the entries required for the project.
- The Special Construction category used in the cost estimate is appropriate for the following:
  - Solar system
  - Piling and other special foundations
  - Engineered fill
  - Fallout protection
  - Other
- Unusual but pertinent entries for the project, such as raised flooring, relocation, temporary facilities (during the time of construction), and other items should be included.

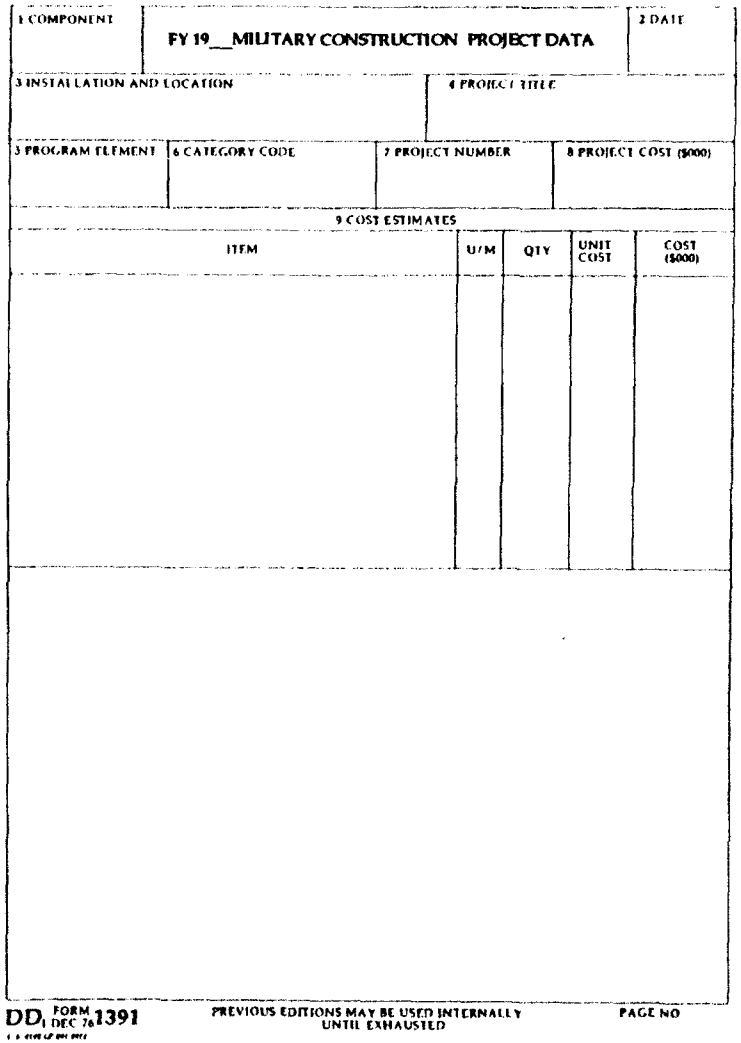
Another helpful piece of information comes in the form of a checklist developed for use by the Navy to assist their personnel in the preparation of the DD Form 1391. The checklist, shown in Figure 2-24, includes many of the factors and categories of information which will be required in any submission.

The final two pieces of information that should be included in the DD Form 1391 (Figures 2-25 and 2-26) are the Certificate of Compliance and Certificate of Savings.

The Certificate of Compliance (Figure 2-27) is a congressionally imposed requirement to certify that implementation rules are not being violated. The certificate must be signed by the commanding officer of the activity and the host COs, if applicable. This responsibility cannot be delegated.

The Certificate of Savings (Figure 2-28) is required for each self-amortizing project.

In some cases, an expanded or more detailed version of the cost estimate may be required. General guidance in the preparation of cost estimates typically centers around the proper use of standards of measure and the proper use of rounding techniques. Guidance for these areas follows.



1 COMPONENT	FY 19__ MILITARY CONSTRUCTION PROJECT DATA			2 DATE
3 INSTALLATION AND LOCATION		4 PROJECT TITLE		
5 PROGRAM ELEMENT	6 CATEGORY CODE	7 PROJECT NUMBER	8 PROJECT COST ($000)	

9 COST ESTIMATES

ITEM	U/M	QTY	UNIT COST	COST ($000)

DD FORM 1 DEC 76 1391 — PREVIOUS EDITIONS MAY BE USED INTERNALLY UNTIL EXHAUSTED — PAGE NO

Figure 2-25. DD Form 1391

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1 COMPONENT	FY 19__MILITARY CONSTRUCTION PROJECT	2 DATE
3 INSTALLATION AND LOCATION		
4 PROJECT TITLE		5 PROJECT NUMBER

DD FORM 1391e DEC 74 — PREVIOUS EDITIONS MAY BE USED INTERNALLY UNTIL EXHAUSTED — PAGE NO

Figure 2-26. DD Form 1391e

CERTIFICATE OF COMPLIANCE
for
Minor Military Construction Projects Undertaken Under
Authority of
Title 10, United States Code, Section 2805

Military Department or Agency:_____

Installation:_____

Project Description, specific purpose, and cost:_____

I certify that the project described above is in compliance with 10 USC 2805 and Department of Defense implementing regulations. Further, the project is essential and represents the minimum requirement for the specific purpose to be supported by the project. I have taken every reasonable action to verify the accuracy of these statements.

Responsible Official:

Name, Position, Title _____ Signature _____ Date _____

I hereby subscribe to the above statements of the responsible Approving Officer(s):

Date _____ Name, Rank, Position _____ Signature _____

Date _____ Name, Rank, Position _____ Signature _____

Figure 2-27. Certificate of Compliance

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CERTIFICATE OF SAVINGS
for
Self-amortizing Unspecified Minor Construction Projects
Undertaken Under
Authority of Title 10, United States Code, Section 2805

Military Department or Agency:_____

Installation:_____

Project Description:_____

_____

_____

_____

_____

Discounted project cost:_____

Discounted project savings:_____

Payback period:_____

End use source of savings:_____

_____

_____

Year(s) savings will be realized:_____

I certify that the cost and savings identified above are correct. I have taken every reasonable action to verify the accuracy of these statements.

Responsible Official:

Name, Position, Title	Signature	Date

Figure 2-28. Certificate of Savings

- Area measure: Always round up to a higher square foot (SF) amount in units no smaller than 100 SF. For example, an area requiring 3215 SF would be rounded to 3300 SF.
- Dollar amounts: The dollar amounts will be computed by either a unit cost X or a unit of measure to determine a total cost by using a lump sum (LS) amount. When presenting dollar amounts, however, the following standards should be observed:
  - Unit costs are rounded to the nearest dollar, except for unit costs under $5.00; over this amount rounding should always occur.
  - Lump sum amounts under $50,000 should be combined into one LS amount and rounded to the nearest $10,000. Other amounts should be rounded as indicated in the chart below.

Project Estimate ($000)		Rounding Guidance	
Up to	1,000	to nearest	10,000
Between	1,000 and 5,000	to nearest	50,000
Between	5,000 and 10,000	to nearest	100,000
Between	10,000 and 15,000	to nearest	200,000
Between	15,000 and 20,000	to nearest	500,000
Over	20,000	to nearest	1,000,000

The completed package of information, including the DD Form and the Functional and Technical Requirements, is sent to the appropriate approval or headquarters agency for approval and entry into the formal congressional funding and approval chain. In the interim, projects with a high likelihood of approval and continuity are assigned funding for design and entry into the next phase of the process.

Resources and Assistance

A comprehensive reference list appears in Part 3. Additional sources or references that can be used to help prepare detailed information concerning the equipment and facility requirements can include:

- JCS Pub 19 series: This series of volumes can offer assistance in the understanding of and response to the AM. Its suggested format for the information presented in the AM can also serve as the basis for the preparation of an Acquisition and Integration Plan.
- DoD Construction Criteria Manual: DoD-4270.1-M. This manual provides guidance in determining space requirements, appropriate construction types, finishes, and other specifications. This manual serves as the main reference for construction criteria; however, the Services typically have additional complementary information in other sources.
- CCDH, Volume 2: This volume provides generic information for typical spaces within the command center. Each space is described as a "functional area" where specific mission functions can be effectively accomplished. All relevant information is contained on only eight pages. This format allows the project manager of an upgrade to remove the eight pages for a specific space and copy them for distribution to those involved in a particular function (J2 for Intel Watch, J3 for Ops Watch, etc.). This generic information can be used in the preparation of specific functional requirements for a proposed project.
- Other documentation: Typically, each Service and command has established unique policy, procedural, and guidance documentation relating to specific needs within a command center. Agencies tasked with the preparation of information during this phase should refer to these documents to establish precedence or authority.

Formal Documents

The DD Form 1391, Certificate of Compliance, and Certificate of Savings are shown in Figures 2-25, 2-26, 2-27, and 2-28.

Informal Documents

Forms and associated information concerning informal documentation associated with this phase are presented in Figures 2-29 through 2-39.

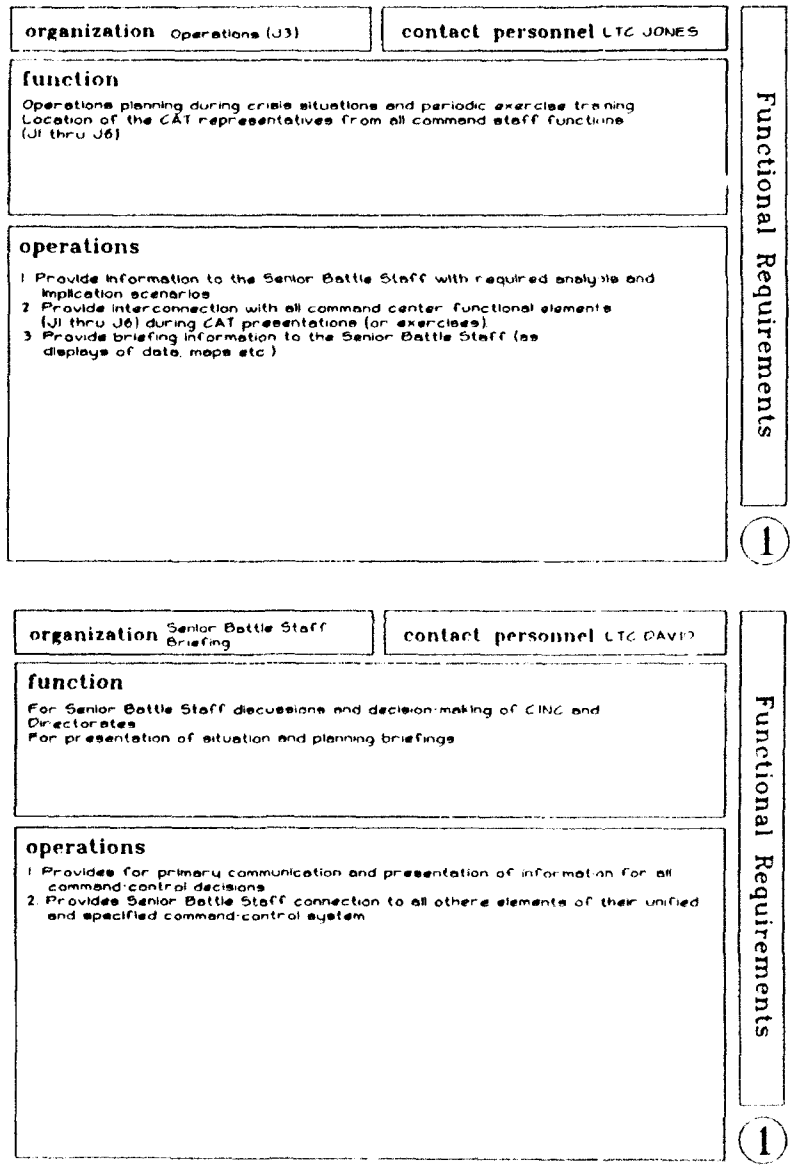


Figure 2-29. Requirements Development Form 1

organization CINC | **space** Senior Battle Staff Briefing

operations Briefings and discussions for command control decisions

activities

1. Senior Battle Staff discussions for command control decisions
2. Presentation of situation and planning briefings
3. Conferencing connection by voice communication to all other U&S command centers

personnel

CINC, Deputy and 6 Directorates Up to 16 support staff from Directorates Up to 35 Command Center staff for 2 briefings

equipment

1. Senior Battle Staff table/desk workstations for light with required voice phones
2. Directorate support staff center for 16 w/WIS terminals and voice phones
3. 4 large-screen display (96X60) units
4. 2 lecterns
5. DEFCON display w/world clocks
6. 3 television cameras
7. 5 television monitors

comments:

APES

(2)

organization Operations (J3) | **space** Senior Battle Staff Support Center

operations Day-to-day operations and CAT Situation Operations

activities

1. Day-to-day J3 Ops
   a. Maintain Ops Division SOP mission thru preparing plans, briefings, messages and reports
   b. Coordinate current actions center operations
2. CAT Operations
   Maintain CAT mission thru monitoring, analyzing, planning, and presenting crisis situation conditions and planning options

personnel

14 Operations (J3) personnel with additional total command personnel from 18 to 30 depending upon CAT make-up during operations

equipment

Day-to-day (J3) workstations (14)
1. Modular workstations w/15 sq ft surface, 8 linear ft bookcase, file drawer & chairs, 12 sq ft white board. Space for PC terminal and phone

CAT Situation workstations (up to 38)
1. Director workstations (for 2) of 15 sq ft surface, 8 linear ft bookcase, 3 chairs, 1 file drawer
2. Modular workstations for 36 with 10 sq ft surface, 3 linear ft bookcase, 1 chair (share terminals)

comments: The day-to-day use of the Battle Staff support area will require the space to be adjacent to other J3 Division chairs

APES

(2)

Figure 2-30. Requirements Development Form 2

organization Operations J3 | **space** Battle Staff Support Center

equipment name	ape	conditions generated: senior	air cond.	heat	other	explanation	conditions required: air cond.	heat	light	elect.	other	explanation
PC Terminals	all					Tempest Security	X			X		
TV Displays	2a	X		X			X			X		Control glare
Red/Black phones	all					Tempest Security						signal line sep.
Reproduction	all			X						X		
AOBC	2a											
AMPS	2a											
FAX Machine	all	X		X						X		
Display maps	all								X			Control glare
World clocks	2a											

Equipment Data

(3)

organization CINC | **space** Senior Battle Staff Briefing

equipment name	ape	conditions generated: senior	air cond.	heat	other	explanation	conditions required: air cond.	heat	light	elect.	other	explanation
Conference Station	all					Tempest Security						
Support Station	all					Tempest Security						
Comm. Support	all					Tempest Security						
Lg Screen Display	2			X								
R Screen Projector	2	X		X		Isolate Noise	X	X		X		Special Power
TV/Video Camera	2			X								
Lectern	2								X	X	X	Conn. w/Comm
DEFCON Status Bd	all											

Equipment Data

(3)

Figure 2-31. Requirements Development Form 3

operations CINC

space Senior Battle Staff Briefing

code	requirements	code	requirements
NI	1 Space for Senior Battle Staff to work together effectively at common desk/table		
NI	2. 4 large-screen displays w/ several TV monitor units for briefings presented and controlled from lecterns		
NI	3 Security level for TS briefings plus an area for SI level interconnection to other command centers		
N2	4 Adjustable lighting to accommodate briefings conditions and prevent glare on WIS terminals		
NI	5 Sound system and room acoustical quality to allow for effective large group briefings and Battle Staff discussions		

needs codes
N - necessary (lack of seriously impairs function)
I - important (lack of impairs function)
H - helpful (lack of slightly impairs function)

purpose codes
1 - activity of function
2 - health or safety
3 - morale
4 - security
5 - equipment of performance
6 - other

Requirements

④

operations CINC

space Senior Battle Staff Briefing

code	requirements	code	requirements
NI	1 Area for 14 Operations Division (J3) workstations and for up to 38 CAT workstations	N4	4. Security conditions for personnel and signal shielding
I-1	2 CAT workstations need to be able to adjust into a variety of cells ranging from 2 to 8 persons each and still be separate from other groups	I-1	5 Environmental conditions to allow a large number to work efficiently and effectively without extensive visual or auditory distractions
NI	3 CAT Director (& Deputy) need to have overview of total space and in prime location to see displays and monitors	I-2	6 Overhead and desk/surface lighting that does not cause distracting glare on terminals or displays

needs codes
N - necessary (lack of seriously impairs function)
I - important (lack of impairs function)
H - helpful (lack of slightly impairs function)

purpose codes
1 - activity of function
2 - health or safety
3 - morale
4 - security
5 - equipment of performance
6 - other

Requirements

④

Figure 2-32. Requirements Development Form 4

common use spaces Battle Staff Support Center Personnel

space type:	how often used:	for how long:	number of people:
Briefing Room	Day to-day operations 3 times/wk.	1 hour each	3 to 10
	CAT Operations 2 times/day	30 minutes each	4 to 8

forecast CAT personnel

nature of change:	impact on: (space type, quantity, requirements)	date anticipated:
The implementation of the WIS terminals will provide a more extensive connectivity between the BSSC and the other command staff function areas	1. Increased use of PC/WIS-CUS terminals by all CAT personnel in the BSSC 2. With greater connectivity between BSSC and command staff function areas fewer personnel will actually need to be in the BSSC	within 2 years

Common Use Spaces / Forecast

⑤

common use spaces Senior Battle Staff

space type:	how often used:	for how long:	number of people:
SI Briefing/Discussion Room	Daily during crisis situation periods	Approx. 2 to 3 hrs per day when needed	4 to 8

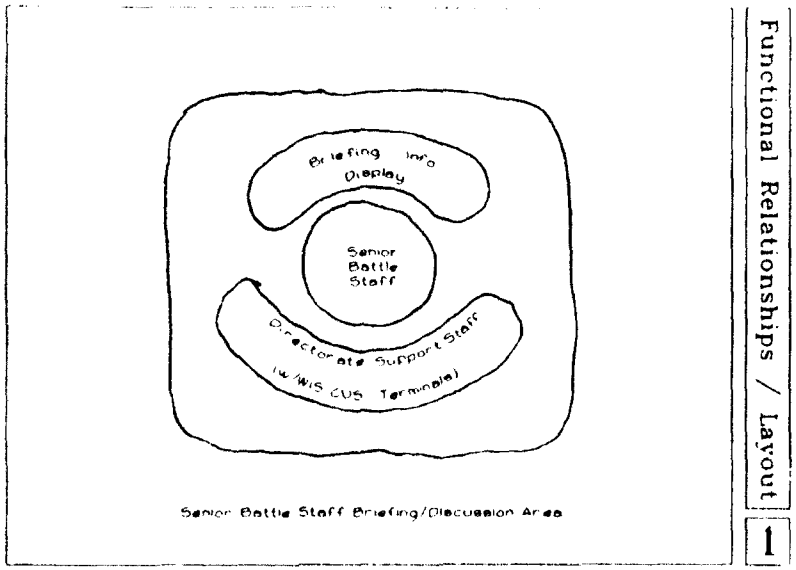
forecast Senior Battle Staff

nature of change:	impact on: (space type, quantity, requirements)	date anticipated:
As the WIS continues to evolve situation analysis and planning options will be transferred directly from the WIS-CUS terminal to briefing large-screen displays and TV monitors	Increased use of WIS-CUS terminals in Senior Battle Staff sessions by members at their desk/table workstations	Next 3 to 5 yrs

Common Use Spaces / Forecast

⑤

Figure 2-33. Requirements Development Form 5



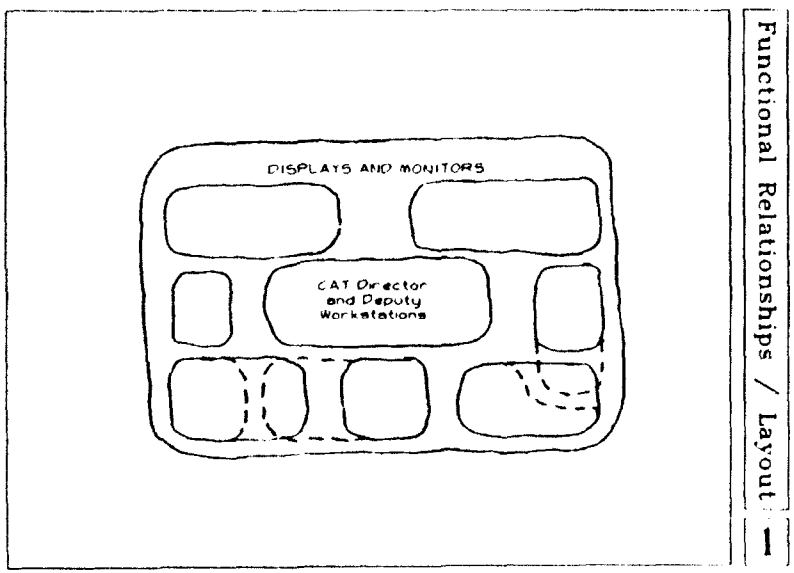
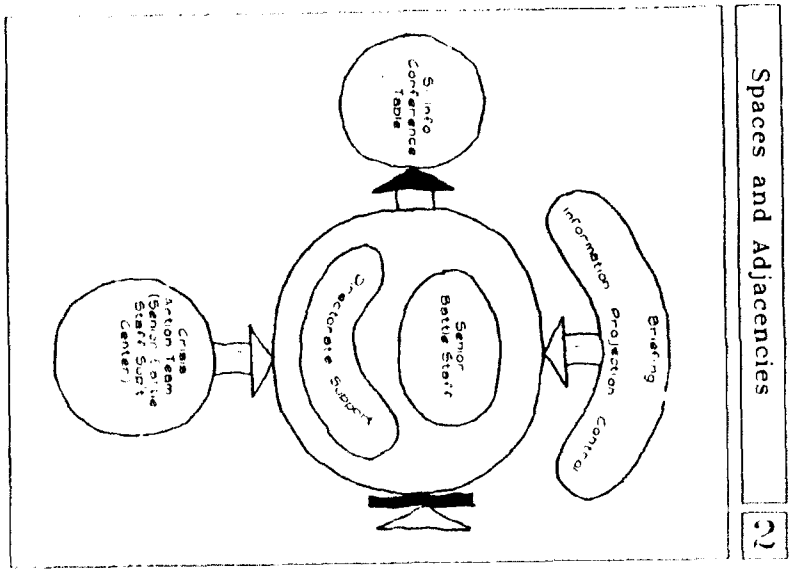


Figure 2-34. Requirements Presentation Form 1



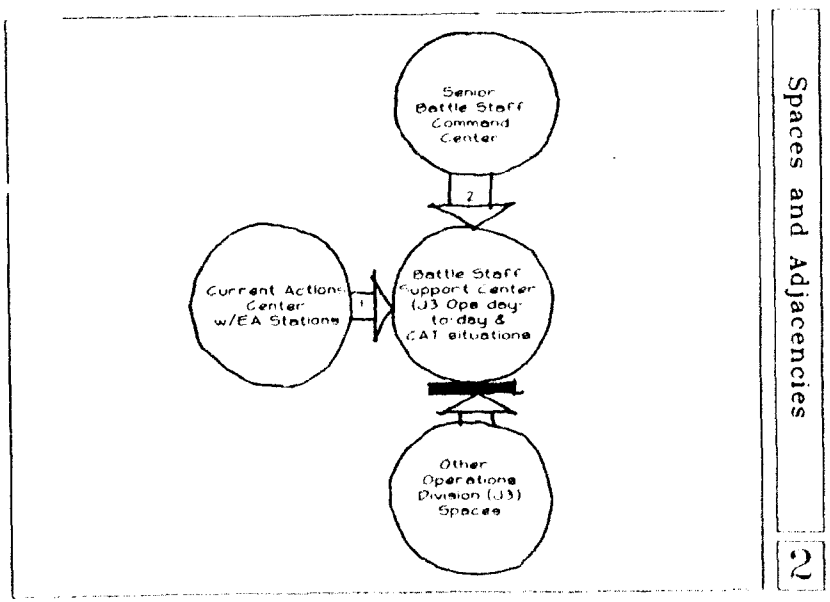


Figure 2-35. Requirements Presentation Form 2

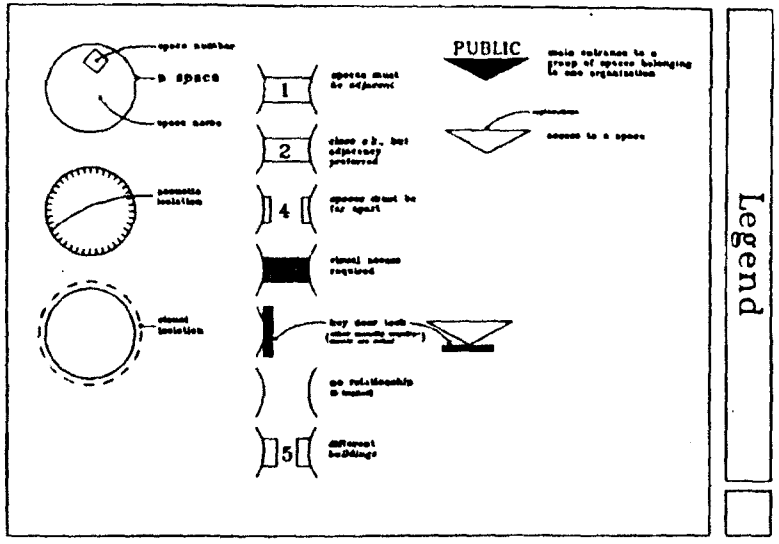


Figure 2-36. Legend

square feet

2,000 to 2,200 sq ft

adjacent spaces

Primary - SI Briefing Room
Secondary - Battle Staff Support (CAT)

personnel

CINC
Deputy CINC
Up to 16 Directors
15-20 Support Staff
Up to 25 Command Center personnel
2 Briefers

requirements

1. Secure environment for sensitive briefings
2. Tempest and EMP/HEMP shielding
3. Large screen display system with 4 screens. Several TV monitor units to allow a clear view of information presentation to all assembled.
4. Acoustical design to provide voice clarity and containment of discussion within space.
5. Fully adjustable lighting system to allow the reading of material during discussions without glare or distractions on VDT's and display screens
6. HVAC systems designed to provide optimal thermal comfort for room capacity
7. Fire protection/life safety requirements to meet applicable standards.

space Senior Battle Staff

organization CINC

Detailed Functional Requirements 3

square feet

2,250 to 2,500 sq ft

adjacent spaces

Primary - other operations division spaces and Current Actions Center
Secondary - Senior Battle Staff

personnel

CAT Director
CAT Deputy Director
10-15 Operations personnel
15-30 additional Command Center personnel as needed

requirements

1. Flexible space to allow for the variable CAT composition design to allow visual access to all parts of space by CAT Director and Deputy Director
2. Physical security to allow only entry of authorized personnel
3. Tempest and EMP/HEMP shielding
4. Television monitors with links to Large Screen Display System in the Command Center
5. Acoustical treatment to minimize distractions due to conversations telephones and electronic equipment
6. Lighting system design to minimize glare on VDT's and TV monitors
7. Flexibilty of furnishings to allow for the creation of working "cells" within the CAT for 2-8 people
8. HVAC systems designed to to provide optimal thermal comfort levels under capacity conditions

space Battle Staff Support

organization Ops (J3)

Detailed Functional Requirements 3

Figure 2-37. Requirements PresentationForm 3

organization CINC | **space** Senior Battle Staff Briefing

Equipment Data

equipment name	ape	conditions generated: smoke	air cond.	heat	other	explanation	conditions required: air cond.	vent	light	elect.	other	explanation
Conference Station	all					Tempest Security						
Support Station	all					Tempest Security						
Comm Support	all					Tempest Security						
Lg Screen Display	2			X								
R Screen Projector	2	X		X		Isolate noise	X	X		X		Special power
TV/Video camera	2			X								
Lectern	2								X	X	X	Conn w/Comm
DEFCON status Bd	all											

4

organization Operations J3 | **space** Battle Staff Support Center

Equipment Data

equipment name	ape	conditions generated: smoke	air cond.	heat	other	explanation	conditions required: air cond.	vent	light	elect.	other	explanation
PC Terminals	all					Tempest Security	X			X		
TV displays	2a	X		X			X			X		control glare
Red/black phones	all					Tempest Security						signal line sep
Reproduction	all			X						X		
AOBC	2a											
AMPS	2a											
FAX Machine	all	X		X						X		
Display maps	2a								X			control glare
World clocks	2a											

4

Figure 2-38. Requirements PresentationForm 4

common use spaces Senior Battle Staff

space type:	how often used:	for how long:	number of people:
SI Briefing/ Discussion room	Daily during crisis situation periods	Approximately 2 to 3 hours per day when needed	4 to 8

forecast Senior Battle Staff

nature of change:	impact on: (space type, quantity, requirements)	date anticipated:
As the WIS continues to evolve, situation analysis and planning options will be transferred directly from WIS-CUS terminal to briefing large-screen displays and TV monitors	Increased use of WIS-CUS terminals in Senior Battle Staff sessions by members at their desk/table work-stations	Next 3 to 5 years

Common Use Spaces / Forecast

5

common use spaces Battle Staff Support Center personnel

space type:	how often used:	for how long:	number of people:
Briefing room	Day-to-day operations 3 times/wk. CAT operations 2 times/day	1 hour each 30 minutes each	5 to 10 4 to 8

forecast CAT personnel

nature of change:	impact on: (space type, quantity, requirements)	date anticipated:
The implementation of the WIS terminals will provide a more extensive connectivity between the BSSC and the other Command Staff function areas.	1 Increased use of PC/WIS-CUS terminals by all CAT personnel in the BSSC 2 With greater connectivity between the BSSC and command staff function areas, fewer personnel will actually need to be in the BSSC	within 2 years

Common Use Spaces / Forecast

5

Figure 2-39. Requirements Presentation Form 5

Phase 4. Facility Design/Equipment Development

Objectives

The purpose of the fourth phase of the process is to plan the design and development of the equipment or systems and the physical modifications to the command center facility. During this phase, development will be coordinated and the facility design reviewed for compliance with requirements. The overall objective is to produce a final equipment, system, and facility design that is responsive to the needs of the command center.

Participants

The participants in this phase should be the same team that prepared the requirements package and other documentation. This promotes continuity of the project objectives and reduces the effort necessary to bring new members "up to speed" with the project.

Other participants involved in the work accomplished during this phase include:

- Architects/engineers
- Equipment designers/engineers
- Software and system development engineers
- Human factors engineers.

These personnel, while directly involved in this phase, are not discussed in the guidance portions. Their responsibilities have been clearly identified and are directly related to preparing the product/system/design that was specified in the requirements package developed during the previous phase.

Guidance

One of the first matters to attend to during this phase is the coordination and management of the project. At this point, the need has been identified and justified, requirements have been developed, and the system and equipment development or facility modifications have been requested. With all of these activities occurring concurrently, the project officer must make sure that all aspects are properly coordinated. Situations such as equipment delivery prior to facility design can be avoided with careful planning and coordination. One means of accomplishing this is through the development of a Program Management Plan (PMP).

The PMP is a tool which addresses a course of deliberate and thoughtful management to ensure that the project achieves the required increased capability, within the budgeted amount and on schedule. The PMP typically outlines the goals and objectives of the project and orients management's attention to the accomplishment of those goals. It also provides a framework for problem solving and establishes a systematic approach for rational program management.

A typical organization of the information in the PMP is as follows:

- Introduction: A brief discussion and overview of the specific command center improvement effort.
- Requirement: A discussion of the ROC which was validated and serves as the basis for the project.
- System description: A discussion of the system, equipment, or additions planned for the command center.
- Facility description: A discussion of the facility modifications required to support the system equipment modifications and additions at the command center. The discussion should address how the facility modifications will support any changes in command center operational procedure.
- Integration: A delineation of the plan or methodology by which all the parts and pieces of the improvement effort will be coordinated. The system or equipment development, design, and installation must be coordinated with the facility design and construction. Utility and mechanical requirements, as well as delivery schedules and start-up timing, must be coordinated. The integration portion of the PMP is critical to the overall success of the plan.

The importance of the PMP cannot be overemphasized. A methodically developed plan will add to the quality of the facility and help avoid costly delays due to poor planning and coordination.

During the beginning of this phase, while the command center is concentrating on the development of the PMP, the architect and engineer will begin preparation of a design solution for the command center facility modifications or new facility construction. The design(s) that are being developed are based

upon the package of requirements information prepared during the previous phase. Prior to beginning the design, the architectural/engineering team meets with the facility users (typically the team responsible for preparation of the package) to review, clarify, and validate the information as presented. Armed with this understanding of the project's needs, the design team begins working on a preliminary or conceptual design specification.

The conceptual solution (typically occurring about one-third of the way towards a finished design) is then presented to the facility users at the command center for their review and comment. This review is an extremely important point in the process, because it gives the users an opportunity to see if and how their requirements were incorporated into a design and allows them to comment on or suggest changes to the design. The facility users have the final say during this time as to whether the design will be accepted or rejected. The impact of a good or bad review will be felt ultimately in the overall success or failure of the completed facility.

The method by which the designers typically present a conceptual design is the concept design package. The concept design package, shown in Figure 2-40, is the collection of documents which describes the concepts and basic design of a project. It includes:

- An area site plan for building groups
- A project site plan
- Floor plans showing the functional layout; the scale will be such as to permit an entire floor plan to be drawn on one sheet
- Typical cross-sections showing exterior materials to be used
- Elevations indicating principal exterior materials to be used
- An outline of materials and methods of construction with a schedule of typical finishes
- Communications systems requirements, to include a statement reflecting coordination of such requirements with the local communications-electronics officer
- A design narrative discussion to reflect types and capacity of heating, ventilating, and air-conditioning systems considered, with a description of the system selected for the facility
- A design narrative discussion to reflect types and capacity of primary electrical power, conduit, lighting, and other systems considered, with a description of the systems selected for the facility

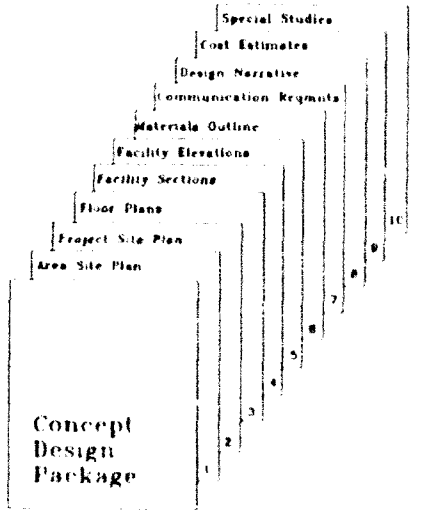


Figure 2-40. Concept Design Package

- Cost estimates for the primary facility and supporting facilities

The concept design package, when completed, is also sent to the appropriate headquarters agency and organization responsible for project management. These groups will, along with the installation, conduct a review of the concept design. The review will typically occur within a relatively short period of time, approximately two weeks. Because of the importance of the review and the short time frame given for the critical evaluation and review of the design, it is imperative that the reviewers prepare themselves to make the best use of this time.

It is a fairly simple matter to organize and prepare the team for the concept design review. Essentially, five steps are involved:

- Advance planning
- Training and familiarization
- Final scheduling
- Conducting the review

- Packaging the comments.

Use of the suggestions presented here can make the review a very productive, beneficial experience.

Advance Planning

The initial step in preparation for the review simply involves tracking the architects' progress to determine a possible target date or time frame in which the review will occur. Once a reasonably certain date can be determined, the team should be selected and notified. Once again, the team that has functioned during the previous phases and activities should participate in the review. This helps to ensure continuity and reduce familiarization time for new members.

Timing and Familiarization

The goal in this step is to make all team members aware of exactly what the review is and what their role will be. Local guidance, in the form of pamphlets, regulations, and other assistance, should be made available to assist in this. In addition, it would be beneficial to assemble the team for a presentation by the base or facility engineer concerning the review. The engineer will be able to relate experiences during previous reviews and offer suggestions for the successful completion of the impending review.

Another important aspect of this step involves the refamiliarization of all team members with the project itself. This is essential for all new members and provides reinforcement for current members. Previous documentation should be made available to team members. Copies of requirements information should be distributed, and classified sections should be made available at an appropriate central location. Documents that will assist in refamiliarization with the project include:

- ROC document
- System Development Notification
- TA/CE or PE
- Acknowledgment Memorandum
- DD Form 1391
- Functional/Technical Requirements
- Program Management Plan.

These documents, along with any other supporting material, form the core of information for the project, and should be reviewed prior to the concept design review. The most beneficial and intelligent review of a design can only be made when the reviewer has a comprehensive working knowledge of the requirements and capabilities that form the basis for a design solution.

Final Scheduling

Once the date for the review period is confirmed, team members should once again be notified. This should be done immediately upon receipt of the confirmed date so that replacements, if needed, can be selected and familiarized. When the team is verified, a schedule should be developed that identifies all events scheduled during the 2-week time frame. A sample format for a schedule of review activities is shown in Figure 2-41.

Points to remember when preparing the review schedule include:

- Conference room reservations for review meetings and work sessions must be made.
- If a limited number of the concept design packages will be available, work rooms should be arranged to allow more than one person to work with the package at the same time.
- An initial review team meeting should be arranged upon arrival of the concept design packages to discuss and confirm the intent and overall objective of the review.
- Time should be allotted initially for the review (approximately 1 week), with remaining time being devoted to team meetings to discuss and resolve issues identified during the review.
- Enough time should be allotted at the end of the review period for the preparation and compilation of all review comments into a package that can be easily understood by the architect.

The completed schedule, along with a letter or note re-emphasizing the importance and ultimate impact of the review, should be sent to each of the review team members at least 1 week prior to the beginning of the review period.

Conducting the Review

The review team members are required to check primarily the functional and, to a more limited extent, the technical aspects of the facility. It is assumed

Concept Design Review Activity Schedule

Project: Tactical Equipment Shop L.I. 166

Monday	Tuesday	Wednesday	Thursday	Friday
			1 Receive Concept Design Review Package Instal	2 Kick off Mtg 10:00 AM *463 Design Review
5	6	7	8	9 Ind Review Group meetings (as req'd)
	Conduct Review			
12 Joint Review Team Mtg 9:00 AM *463 Follow-up	13 Follow up Compl Organize/submit comments to master planner	14 Master Planning Final organ & editing	15 Prepare/Re-produce Comment Pkg	16 Submit Complete Comments Pkg to Dist office

date	activity
June 1	•Concept Design Packages received from COE Dist Office
June 2	• Concept Review "Kickoff Mtg" for distribution of materials. Time: 10:00 a.m. Location: Bldg. 463, Rm. 21. •Begin Concept Design Review
June 9	•Individual Review group meetings
June 12	•Joint Review Team Mtg. to discuss problems and issues. Time: 9:00 a.m. Location: Bldg. 463, Rm 21 •Complete Follow-up Actions
June 13	•Complete Follow-up Actions •Organize Comments and Submit to MP by COB
June 14	•Final organization and editing of comments
June 15	•Prepare for Comment Package Submittal
June 16	•Submit Comment Package to COE Dist.
Mid-July	•Post Concept Design Review Conference (Date, Time and Location to be announced)

Figure 2-41. Example Final Schedule

that the facility users are the "resident experts" concerning the mission that the facility must support upon completion. As stated previously, the reviewers typically have, at this point in the process, the authority to approve or reject concept design or any of its functional provisions during this phase. The using agency has little say in matters concerning the design after the concept design phase. For this reason, the users must conduct a thorough and comprehensive review of the proposed design. In conducting the concept design review, users must check the facility design for compliance with the functional requirements information. Simply stated, the concept design review involves comparing the two documents.

The first phase of the review procedure consists of:

- Checking the concept design for compliance with previously prepared functional requirements information
- Preparing comments, noting areas of noncompliance or suggestions for improvements in the design
- Preparing for the joint review team meeting. In most concept design reviews, users will be working with the following sections of the concept design package:
  - Project site plan
  - Project floor plans
  - Building elevations
  - Building sections
  - Materials outline.

Other sections of the package may be important to the users reviewing certain types of facility designs. During the training and familiarization period, the users should be informed of any other sections to be included. Users must first determine for which sections of the concept design package they are responsible, then compare the concept design to the requirements, using the eight questions below for guidance. These questions represent only general review concerns. Each project may include in its review additional areas of concern unique to the users' mission.

1. Are all spaces accounted for?

The spaces required by each organizational unit should be shown in the functional requirements. Reviewers should compare these spaces to those

provided in the concept design and determine whether all required spaces are mission-critical or extra spaces are provided; make a comment.

2. Are the spaces organized correctly?

In the functional requirements, relationships among spaces were coded by number (refer to the Legend provided in the discussion concerning preparing functional requirements). Key relationships among spaces for each organization may have been included in a diagram. Reviewers should compare required relationships to those found in the concept design. Some discrepancies may have occurred by necessity when spaces were actually laid out. Reviewers should make a comment if key relationships were not delineated.

Relationships in the functional requirements were based on how the organization can best operate. Required relationships among spaces may not be clear. A good way to tell whether the concept design is well laid out is to think about how the organization can best perform its activities. Reviewers should determine whether information, material, or the movement of people or equipment are important, and whether spaces allow for the efficient flow of people, vehicles, equipment, material, paperwork, or information. Reviewers should explain in comments why relationships must be different.

3. Is each space the correct size?

The size of each space was listed in the functional requirements. Reviewers should evaluate how closely the spaces in the concept design match those sizes. Normally, a deviation of 10 percent or less should not create a problem. Differences greater than that may mean wasted space or a space too small to house contents. In the comments, reviewers should note any discrepancies and the reasons they might create a problem.

Another important aspect is shape. Special shapes or room dimensions may have been required. Reviewers should check to see whether proper lengths and widths are provided, think of the activities or equipment that will be used in the space, and note inadequacies in the comments.

4. Is access to and from each space adequate?

Special dimensions of doors or windows may be required to move equipment in or out. Special dimensions, particularly ceiling height, may have been requested so that equipment can be more easily moved within the space. Reviewers should check for these dimensions in the concept design and make sure that the original request and the concept design have provided for the same clearance.

Access might include door or window locations which are convenient. Reviewers should think of the activities for which the space will be used and consider whether travel or vision will be difficult or inefficient. Reviewers should make sure a comment is made about where problems will occur and suggest better locations.

Access should also be considered for the entire building and site. Will traffic routes be congested or hazardous because of activities? Can deliveries be made? Can occupants get in without a long walk? Can emergency equipment reach critical locations? Can waste be removed? If there is any problem in moving people, equipment, or supplies during routine or peak usage, reviewers should make a comment and explain the problem.

5. Will all furnishings and equipment planned for a space fit into it?

Normally, concept design will not show how things are laid out within a room. The equipment and furnishings to be placed in a space are listed in the functional requirements; there might also be a sketch of a desired layout. Reviewers should try to find out whether furnishings and equipment will fit into a space, perhaps by making a quick pencil sketch. (Contents should be drawn to the same scale as the concept design drawings.) Reviewers should make a comment if a problem is apparent.

It is not adequate simply to have all items fit in a space. Reviewers should estimate whether equipment can be used and whether enough space is allowed for servicing stationary equipment. If a space and the items in it cannot be used efficiently, the difficulties should be noted in the comments.

6. Have all special requirements been met?

In the concept stage, a design might not be far enough along for the designer to worry about details. Special requirements identified in functional requirements might be found in the concept design. These special requirements can include health and safety features (lifts, cranes, hoists, elevators, ramps, and docks), or security features. Many may be shown in schematics of building subsystems if schematics were included at this point in the design, but most will be missing. If problems with special requirements are found, reviewers should make comments as needed. They should not make comments when special requirements obviously have not been considered.

7. Can activities assigned to each space be performed there?

After reviewing for particular concerns, reviewers should step back and take a general look at each space. They should think of the people and activities

in the space and mentally determine whether personnel can perform their tasks efficiently. Reviewers should comment on problems anticipated.

In this section it would be effective to use subject matter experts, or users who will be assigned to that particular space.

8. Can the intended mission be carried out successfully in the proposed facility?

Next, reviewers should step back from individual spaces and look at the entire facility. Can several organizations operate within it efficiently? Are the building and site laid out to meet the general needs of occupants and users? If any problems are noted, they should be explained in the comments.

If a concept design does not satisfy requirements, comments should be logged on the worksheets similar to the ones shown in Figure 2-42. Reviewers should note the item or area of the design that does not comply and, if possible, suggest methods for improving the concept design so that functional requirements are satisfied. Comments should be:

- Written legibly
- Stated concisely and clearly
- Organized in a consistent format
- Referenced to the concept design package by page number, drawing number, space number, or other identifier.

In addition, the comments should identify the problem clearly and offer alternative solutions, if possible. A design solution could be technically or functionally unworkable or unacceptable, leave major requirements unsatisfied, or have major flaws which make further review a waste of time. If such major problems exist, reviewers should notify the review coordinator immediately. It will be determined at that point whether the appropriate agencies should be contacted and the review process halted.

Packaging the Comments

Upon completion of the review and the resolution of any issues or problems that surfaced in team sessions during the review period, all comments should be packaged and forwarded to the project management organization for their concurrence. The comments are then sent to the architect for incorporation into the design. In order for the architect or engineer to effectively understand and use the review comments, they must be efficiently organized and packaged.

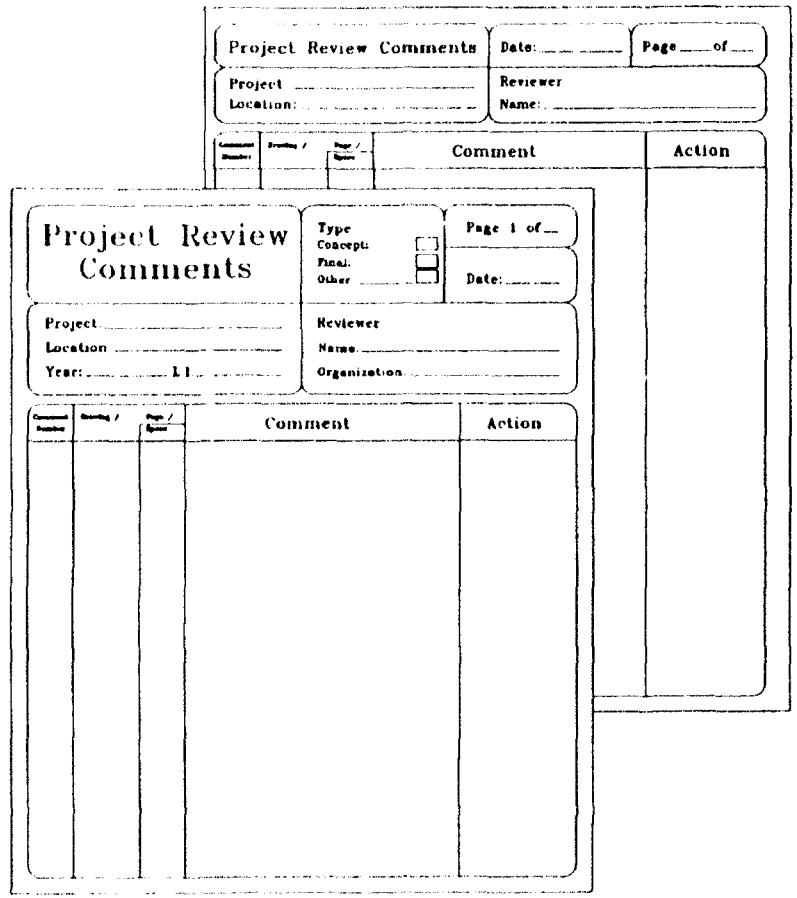


Figure 2-42. Comment Reporting Form

The first step toward preparing a well-organized comment package involves the review of all comment submittals and the elimination of any repetitive or redundant comments. The clarity of the comments should also be examined to make absolutely sure that the intent is clear.

After the comments are edited, they should be organized in a manner which can be easily understood by the architects and engineers. The following categories may help in providing the overall framework for organization:

- Architectural comments
- Structural comments
- Civil/sanitary comments
- Mechanical comments
- Electrical comments
- Communication comments
- Fire protection/life safety comments
- Building security comments
- Other miscellaneous comments.

This division will allow the respective comment groups to be directed to the proper personnel in both the project management organization and the architectural engineering office.

Within each of the major categories, the comments should be organized and referenced by the space name, page and paragraph number, or drawing number in the concept design package to which they refer. An example of this organization is shown in Figure 2-43.

Following the submittal of the review comment package, the comments will be analyzed by the project managers and the architectural firm to determine whether they can be incorporated. This is an evaluative procedure, with factors such as impact on other aspects of the facility, time, cost, and overall feasibility being weighed. If so determined, the suggestion will be incorporated into the final design. In any case, the architect and the project manager will report back to the command center following the analysis to present the results of the review. At that presentation, the command center project team will be informed which comments have been included and which have not. Reasons behind each of the decisions will also be presented.

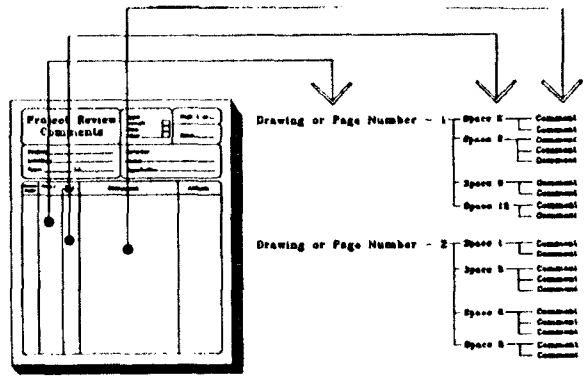


Figure 2-43. Comment Organization

With the completion of the concept design review, the major portion of the command center's responsibilities have been satisfied. From this point on, the team should remain up-to-date in the design efforts leading toward the completion of the final design package. In some cases the team may be asked to conduct a quick review of the final design before the bidding and negotiation process begins. If so, the review will occur very much like that at the concept stage, with the emphasis directed at verifying that the items identified during the previous review have indeed been included in the final project.

Resources and Assistance

Sources or references that may assist during the preparation of the Program Management Plan and completion of the concept design review may include:

- DoD Construction Criteria Manual: This manual provides reference or resource material to assist in validating space requirements, appropriate construction types, finishes, and other aspects of the design. This manual serves as a reference for the architect in completion of the concept and final design. It should be noted, however, that the Services typically have additional complementary information provided in other sources.

- CCDH, Volume 2: This volume provides generic information for typical spaces within the command center. Each space is described as a "functional area" where specific mission functions can be effectively accomplished. All relevant information is contained on only eight pages. This format allows the project manager of an upgrade to remove the eight pages for a specific space and copy them for distribution to those involved in a particular function (J2 for Intel Watch, J3 for Ops Watch, etc.). This generic information can be used in the evaluation and review of the concept design package.
- Other documentation: Typically, each Service and command has established unique policy, procedural, and guidance documentation relating to specific needs within a command center. Agencies tasked with the preparation of information and required reviews of design during this phase should refer to these documents to establish precedence and authority.

Phase 5. Facility Construction

Objectives

The objective of this phase is to oversee the acquisition and integration of systems and equipment, and the construction and occupancy of the new or newly modified command center facility.

Participants

The participants in this phase will, for the most part, remain the same team that has been involved in the tasks and requirements of the previous phases.

The team will be directly involved in the development of a lessons learned report resulting from a careful analysis of the entire process. It will again be indirectly involved in an optional "Post-Occupancy Evaluation" (POE) of the facility.

Because of the complexity of many command center facilities and the intricacies of the POE process, it is recommended that a consultant, skilled in conducting POEs, be contracted to provide the services.

Guidance

The major events during this phase include the construction and occupancy of the new or newly modified command center facility. Included with the occupancy of the facility are the installation and integration of new systems and equipment into the command center operational structure. While the majority of planning and scheduling decisions governing the events taking place during this phase have already been made, a significant amount of additional planning must take place prior to the move into the new facility.

It is important to note that in most command centers the luxury of a complete shutdown for moving is not allowed. There can be situations where new systems being installed must be run in parallel operation with the older systems being replaced; "hot" cut-overs might be required, or continuity of operations might have to be coordinated with higher authorities to secure a backup capability. These are just a few examples of the complex situations that can exist in a command center move; it is imperative that they be orchestrated carefully and expeditiously.

Some of the other considerations which must be recognized in order to ensure a successful transition into a new facility include:

- The final coordination of schedules relating to:
  - Acquisition and delivery of equipment
  - Installation of equipment
  - Testing and start-up of equipment
  - Completion of construction
  - Occupancy
- Preparation for the move
  - Scheduling of personnel to move furnishings and equipment
  - Availability of packing materials
  - Provision of plans and layouts to direct movers to correct spaces and workstations
  - Creation of a priority matrix, because some equipment may have to be in place before other pieces can be moved
- Coordination and scheduling for telephone installation

- Scheduling of premove information meetings to inform all affected personnel within the command center of the intended logistics of the move.

Many of these items, while seemingly minor, can contribute to the overall success or failure of the move. Given the importance of the command center mission, any move should create as little disruption or adverse impact as possible.

When all of the construction and installation have been completed and the facility has been occupied, the project team should be assembled again for the purposes of a critical analysis of all phases of the process. The analysis will culminate in the development of a lessons learned report that will summarize all points, good or bad, which were encountered during the project. Some points to consider during the analysis include:

- Was the initial required operational capability satisfied with the completion and implementation of the project?
- What were some of the successful aspects of the process?
- What were some of the problems encountered during the process?
- Why did they occur?
  - Improper information
  - Incorrect formatting
  - Incomplete information
  - Unanticipated delays
  - Other
- What are some possible solutions to problems encountered during the process?
- What are some of the sources of information and assistance that made certain tasks within the process easier? (A list of resources can be developed.)

The report or document developed during this task can be a valuable learning tool for others in the command center community embarking on similar improvement efforts. The report should refer to the completed documents and include them where possible. The overall intention of any effort such as this is to learn as much as possible from the completed project so that subsequent projects can benefit.

Another method which can be used as an evaluative tool once the facility is completed and occupied is the Post-Occupancy Evaluation. The POE assesses how well an environment (a space or a building) fulfills the needs of the people who use it and helps them accomplish organizational and individual goals. Usually, POEs treat the design of a building as a prediction: the design was meant to be a solution to a programming problem. It is a complex solution because of time and budget constraints and programming requirements set forth by the facility user.

The POE offers an opportunity for feedback; we can learn in a systematic way about the success of design solutions in meeting program requirements. The POE can also assist in the design of new facilities by helping in the refinement of programs for subsequent command center improvement projects.

Finally, the POE offers an opportunity to "fine tune" the already occupied facility to more efficiently meet the needs of the occupants. Often, by the time a completed facility reaches the point of occupancy, the original needs and intent of the design have been long since forgotten.

Since most command center facilities are a complex integration of systems, the occupants may frequently be unfamiliar with its layout or how the designer intended it to work. The POE provides an opportunity to learn both how to use this complex system and how it can be modified to meet its users' changing needs.

The implementation of a POE will typically involve four major steps:

- Identification of the purpose for the POE
- Collection and analysis of facility and occupant data
- Development of an assessment of the situation
- Development of the evaluative report.

The detailed activities within each of the steps will sometimes vary with the specific method, approach, or analytical tools chosen for use by the POE contractor.

Simply stated, once the need for the POE, and the results anticipated from it, have been established, information about the facility, its occupants, and the process is gathered. That information is analyzed and an assessment is developed. The assessment is based upon how well the finished product met the originally stated needs and requirements. The results of the evaluation and analysis are then packaged into a report which documents the successes and

failures of the facility while also making recommendations for improving current operations.

The POE can be a valuable and beneficial tool in terms of both optimizing the new facility as well as improving the outcome of planned facilities as long as it honestly assesses both failures and successes.

If the decision is made to not contract for a POE, the command center staff has options that can be carried out locally. The CCDH can offer the basis for a self-evaluation of a command center facility, either existing or newly completed. The facility space information provided in Volume 2 can serve as the basis for the evaluative decisions. Spaces and requirements presented here can be an example by which to rate existing spaces.

An important point to emphasize is that the process that was initiated by evaluative or needs-identifying tasks does not end with the construction and occupancy of a new facility or with the installation and integration of a new system. The evaluative process should be continued, with new ideas and suggestions for the improvement of the command center always being encouraged and actively sought.

Resources and Assistance

Sources or references that can assist during this phase involving the evaluation of the newly completed and occupied facility include:

- CCDH, Volume 2: The CCDH provides assistance in many of the tasks required during this phase. This volume provides generic information for typical spaces within the command center. Each space is described as a "functional area" where specific mission functions can be effectively accomplished. All relevant information is contained on only eight pages. This format allows the project manager of an upgrade to remove the eight pages for a specific space and copy them for distribution to those involved in a particular function (J2 for Intel Watch, J3 for Ops Watch, etc.). This information can be used as a generic reference or optimum model against which existing or newly completed spaces are evaluated.
- Other documentation: Typically, each Service and command has established unique policy, procedural, and guidance documentation relating to their specific needs within a command center. Agencies tasked with conducting critical reviews of a specific project process should refer to these documents to establish precedence or authority.

In addition, there are many private-sector sources of information and assistance relating to the POE. These should be referred to, or a specialist consulted, when trying to determine whether or not to conduct a POE.

Forms for Local Reproduction

Forms for requirement generation and comment reporting are contained in the appendix at the end of this volume. They may be reproduced locally as required.

AN APPROACH TO EVOLUTIONARY ACQUISITION: THE RAPID DEVELOPMENT PROCESS

The Department of Defense has developed and documented a detailed, orderly system by which the CINCs and other military agencies can plan for and fulfill anticipated needs for additions or enhancements to their facilities and equipment. The previous section has discussed one approach to working within that system, the facility delivery process. However, because of the rapid growth rate of technology and the potential for new policies or world situations to drive sudden new requirements, this system alone is not sufficient to supply command centers with the resources they need. As a result, a number of alternative planning and acquisition strategies have been developed. This section discusses one of these alternatives, the rapid development process. Figure 2-44 provides a graphic overview of the process.

The rapid development process is a specific management approach that is intended to field systems sooner than traditional methods can, to lower system costs, and to increase user satisfaction by responding directly and more rapidly to problems perceived by the user. Its abbreviated schedule insulates near-term projects from volatility in funding and allows a system to be delivered within a short period of time (approximately 24 months), which lessens the risk of personnel turnover in midstream. At the same time, it surfaces valuable information about operations and equipment that can be fed back into long-term planning and funding processes.

Rapid development builds on the concepts of rapid prototyping, but the goals of the two processes are different. Rapid prototyping is most effective at validating requirements by creating a product or procedure in response to preliminary requirements and testing it to discover whether those require-

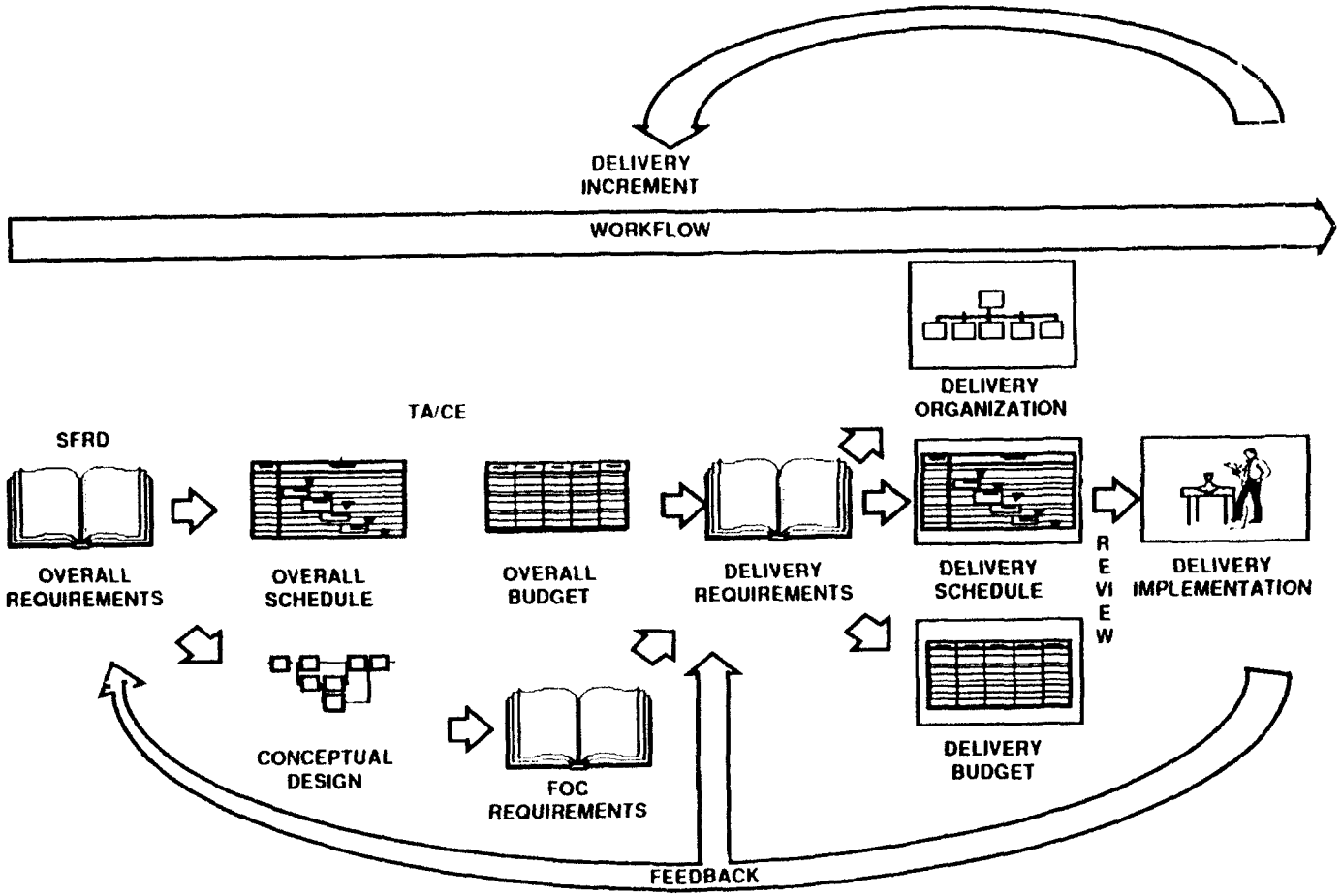


Figure 2-44. Rapid Development Process

ments were sufficient to produce a workable solution. Once the requirements have been refined to a satisfactory degree, development of the product by traditional means takes over. Rapid development, by contrast, seeks to implement systems by revising the end product itself over several iterations.

Rapid development is also a more formalized process than rapid prototyping. It includes specific, tailored approaches to system implementation issues. The basic tenets of rapid development are:

- Incremental deliveries
- Active feedback from product to requirements
- Extensive user interaction during development
- Progressively greater formality.

These tenets are discussed in the following paragraphs.

In a compressed development schedule, it is essential that flexibility for making design alterations remain in the process for as long as possible. Incremental deliveries help to ensure flexibility by allowing individual components of the system to be examined as soon as they are ready. If problems with these components are detected, they can be revised as soon as possible; more importantly, changes can be fed into the design of any related components that have not yet been produced. To realize the potential benefits of incremental deliveries, a continual awareness is needed of how all the system components interrelate, and of how changes in one part impact the remainder of the system. Incremental delivery offers an additional benefit: it introduces change gradually into the operations of an organization and allows personnel time to adjust and train themselves for new conditions.

User interaction at the beginning of the process consists of an initial statement of requirements by the users, review by them of specifications and designs, and determination of which components of the system must be delivered first or given priority over the remainder of the system. Users must continually monitor the implementation of the system, and assist in cost/capability trade-offs as issues become apparent. Users test the system, and operate it with the intention of revealing its weaknesses. Their operational experience with it is translated into changes in system requirements. The system is then rebuilt to the new specifications and the testing process is repeated. Finally, after any number of iterations, users accept the system and the rapid development cycle is complete.

The greatly shortened delivery life cycle promised by the rapid development process depends on progressive formalization of the supporting processes. Because of the dynamic nature of the actual product development, schedules, budgets, reviews, and similar processes must remain stable; if they are not, the entire project is in chaos. Plans for the preparation of documentation, the application of quality standards, testing and evaluation procedures, logistics support, training, and audits should all be fixed ahead of time, so that these processes can simply be executed when the appropriate product milestones are reached.

Although the rapid development process capitalizes on unconventional development processes, in the most successful applications it relies on an overall architecture such as the command center system architecture. The architecture provides a target toward which a system under development should evolve, and identifies the linkages between that particular system and other components.

The rapid development process has been used at EUCOM and has resulted in the fielding of three user-responsive systems: an integrated transparent workstation interface, an automated message handling system based on nondevelopmental components, and a state-of-the-art map archival system.

PART 3. CURRENT COMMAND CENTER REFERENCE WORKS

INTRODUCTION

In command center improvements no less than in command center operations, information is critical to successful decision-making. Although the CCDH attempts to provide readers with basic information across a spectrum of management and technology issues, no single source can provide comprehensive background in sufficient detail to answer every question that will arise in the course of a command center project. Command center staff are encouraged to use all the information resources available to them: the CCDH, the services of experts in various fields, and a range of government and commercial publications. Figure 3-1 (on the following page) shows how several essential sources contribute to the knowledge base of a command center staff member.

The publications in the following list include, first, DoD policy documents that will have an impact on how command centers operate and how modifications are made to them, and, second, other references of various types that may prove useful. The latter portion of the list is organized according to the command center subsystem the references support. The list is not intended to be all-inclusive or mandatory. It consists of books, magazines, newsletters, and government documents that experts in the various technology and management areas have recommended. This is merely a starting point. It is certain that some publications not mentioned here are of equal value to those included in the list. Readers are encouraged not only to use other sources, but to alert the CCIP staff to significant new references for inclusion in future editions.

The notes following each reference give an indication of what topics the publication covers and its technical depth. The majority of the references are suitable for readers who are not yet technical experts. Where the assumed level of knowledge is significantly higher or lower than average, the contributors to the list have made note of that fact.

All of these publications are assumed to be readily available. CCIP products published by DISA/JTC3A are distributed to members of the command center community. Readers who have not received recent CCIP factsheets, newsletters, and other products can call the CCIP office and ask to be placed on the list. Other government publications should be obtained from the Defense Technical Information Center (DTIC) or Government Printing Office (GPO). For publications from commercial firms and magazines that are not commonly carried on newsstands or in computer stores, an address or telephone number is provided.

Note: Documents listed as products of DISA/JTC3A and dated before 1991 may appear in DTIC under the agency's previous name, the Defense Communications Agency Center for Command and Control, and Communication Systems (DCA/C4S).

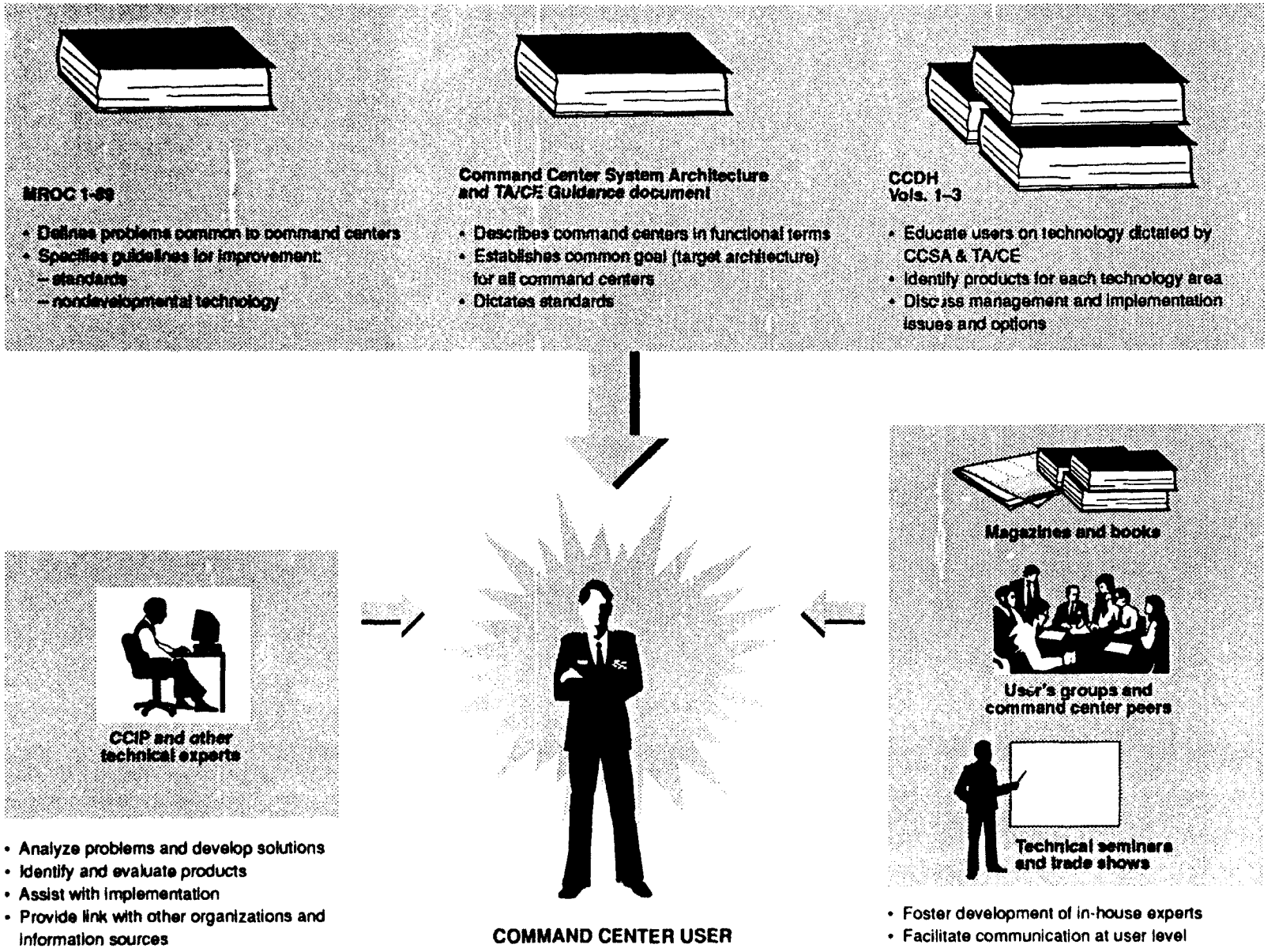


Figure 3-1. Information Resources for the Command Center User

DOD POLICY DOCUMENTS

CJCS MOP 50, *Command, Control, and Communications Systems Master Plans, Assessments, and Evaluation*, Joint Staff

This memorandum of policy addresses the C3 System Master Plan, and the assessment and evaluation of C3 systems. It complements SM-684-88; whereas that document provides policy, the MOP shows how planning, assessment, and analysis interrelate and consolidates the guidance governing these activities. It will help users expedite the preparation of C3SMPs and document the relationships between their C3 systems and processes and the PPBS.

***Command Center System Architecture and TA/CE Guidance*, 30 September 1990, Defense Information Systems Agency**

The CCSA and TA/CE Guidance provides a detailed architecture for the command center subsystems named in MROC 1-89. It identifies a target set of capabilities that serves as a goal to drive command center improvements. It also specifies a current architecture, based on what is currently feasible, that will assist users in making evolutionary enhancements to their command and control systems. A revised edition of this document, due to be published 30 September 1991, will become the basis for the next edition of the CCDH.

DoD Directive 5000.2, *Defense Acquisition Management Policies and Procedures*, Undersecretary of Defense for Acquisition

This instruction provides a thorough event-oriented management process for acquiring quality products for DoD use. It emphasizes effective acquisition planning, communication with users, and aggressive risk management. An annex, 5000.2-M, contains associated management documentation and reports.

DoD Directive 5000.37, *Acquisition and Distribution of Commercial Products*, Undersecretary of Defense for Acquisition

This directive makes official the DoD policy of using non-developmental commercial products where possible to fulfill defense objectives.

***Multicommand Required Operational Capability 1-89 for Command Centers*, April 1991, Joint Staff**

MROC 1-89 identifies deficiencies that are common to all or most of the fixed NMCS and U&S command centers, and provides Joint Staff direction for resolving these deficiencies in a coordinated manner. It conceptualizes the command center as a system comprising four subsystems, communications, information processing, briefing and display, and facilities.

***Multicommand Required Operational Capability for Multilevel Security (MLS) in Command, Control, Communications, and Intelligence Systems*, February 1991, Joint Staff**

The MROC for MLS identifies the common requirement for multilevel security in command centers. It discusses the founding of the MLS Technology Insertion Program Office.

SM-684-88, *Policies and Procedures for Management of Command, Control, and Communications Systems*, Joint Staff

SM-684-88 discusses responsibilities and procedures for identifying and validating requirements and for approving ROCs for C3 systems.

***Target Architecture and Implementation Strategy for the Joint MLS Technology Insertion Program*, Defense Information Systems Agency, MLS Technology Insertion Program Office, March 1991**

This document contains the target architecture for MLS systems, and discusses how the requirements of the target architecture will be achieved. Five near-term architectures illustrate technology that is currently available to provide multilevel security capabilities in the areas of guards, workstations, LANs, database management systems, and hosts.

JCS Pub 0-2, *Unified Action Armed Forces (UNAAF)*, Joint Staff

This publication sets forth the principles governing joint operations. It includes guidance governing the exercise of command by the CINCs and describes the command functions of joint commands.

JCS Pub 6, *WWMCCS Objectives and Management Plan*, Joint Staff

As the primary reference on WWMCCS, the six-volume JCS Pub 6 delineates the functions performed by command centers under WWMCCS. It describes the components of WWMCCS and highlights WWMCCS interfaces.

INFORMATIONAL PUBLICATIONS

Sources Relevant to All Four Command Center Subsystems

***BPPBS Primer*, Department of the Air Force**

This document describes the Air Force Biennial Planning, Programming, and Budgeting System. It is an introductory document designed to give the reader a basic familiarity with the organization, responsibilities, and general procedures of the BPPBS.

Joint Pub 1-02, *Department of Defense Dictionary of Military and Associated Terms*, Joint Staff

This document is a comprehensive glossary of DoD and NATO terms.

***FACTSHEET* series, Defense Information Systems Agency Joint Tactical Command, Control, and Communications Agency**

JTC3A issues factsheets in conjunction with its Demonstration and Technology Survey program. Each factsheet takes an in-depth look at a particular technology, providing both a tutorial on the subject and product comparison information. Factsheets are the source for the product information provided in the "yellow pages" sections of Volume 3; readers interested in learning more about a particular product are encouraged to find the source factsheet and read the full product evaluation. Recent factsheets have addressed flat panel displays (Factsheet 88-6), electronic mapping (Factsheet 89-1), and optical scanning (Factsheet 91-1).

***INSIGHT* newsletter, DISA/JTC3A**

Published quarterly, this newsletter presents articles on technology of interest to command centers, documents improvement projects, and publicizes JTC3A's activities on behalf of the CINCs.

***NMCC/ANMCC Engineering Plans* and NMCS Engineering Workstation (NEWS), DISA/JTC3A**

The NEWS system maintains current technical and programmatic information on all existing and planned systems for the fixed command centers of the NMCS. Information from the NEWS is updated quarterly and published annually in Engineering Plans, one for the NMCC and one for the ANMCC. DISA can satisfy ad hoc requests for printouts of specific information from the NEWS.

***Systems Engineering Management Guide*, Defense Systems Management College, January 1990 (available through Government Printing Office)**

This is one of a family of educational guides covering acquisition management within DoD. Total quality management (TQM), hardware and software, testing and evaluation procedures, and integrated logistics support are among the topics covered.

***Datapro Reports on Data Communications* and *Datapro Reports on Telecommunications*, McGraw-Hill, Inc.**

These wide-ranging, multi-volume documents address many aspects of communications and information processing. They are an essential reference for both novices and experts in the fields they cover. One section of each document provides a tutorial on basic technical concepts. Another discusses emerging capabilities and provides product evaluations. Frequent supplements and new editions are sent to subscribers.

Communications Subsystem Information Resources

***Proceedings on Workshop IV, Video Teleconferencing*, DISA/JTC3A, January 1986**

Although this publication is several years old, it remains a valid and comprehensive reference on video teleconferencing for command centers.

***Communications News* magazine, Nelson Publishing, 2504 N. Tamiami Trail, Nokomis, FL 34275**

An applications magazine for voice, networking, video and data communications management. Feature articles include LANs, telecommunications

software, facility issues, international concerns, industry updates, editorials, entrepreneurial observations, new products, a resource list, and letters to the editor.

***Communications Week* newspaper, free to communications professionals, CMP Publications, P.O. Box 2070, Manhasset, NY 11030**

This network newspaper covers industry news, local area networks, wide area networks, internetworking, network management and services applications.

***TE&M (Telephone Engineer & Management)* magazine, 1 East First St., Duluth, MN, 55802**

This biweekly magazine covers "Technology for the Global Telecom Network" from a management perspective. It includes brief reports of the latest news regarding telecommunications business, with feature articles on national policy, management and national government issues, technology updates, trends, and products and services.

***Technical Notes: Transmitting, Switching, Distributing, Interfacing Computer Video Signals* - 1990 edition, Inline, Inc., 625 S. Palm St., La Habra, CA 90631, (213) 690-6767**

This commercially produced notebook provides a brief, basic discussion of video communications processing, including sections on audio, video, computers, high-resolution graphics, HDTV/IDTV, and fiber optics. The book's chart-plus-notes presentation is not slick, but it is a sound, simple introduction to the subject.

Technical Notes: Introduction to Computer Interfacing, Extron Electronics, 13554 Larwin Circle, Santa Fe Springs, CA 90670, (800) 633-9876

This document is a commercially produced, comprehensive collection of information on computer interfacing, switching, and distribution.

***Teleconnect* magazine, 12 West 21st St., New York, NY 10010**

This is an independent guide to choosing, using, and installing telecommunication equipment and services. It includes market reports and reviews; technology news, trends, innovations, and test cases; customer reports; anecdotal stories illustrating industry lessons; and a hardware, software, and services market guide.

***Telephony* magazine, P.O. Box 12960, Overland Park, KS 66215**

A global report on the public network market, this magazine covers issues such as integrating voice messaging and database information retrieval, video conferencing, and Soviet and U.S. telecommunications planning.

Information Processing Subsystem Information Resources

***Information Systems Security Products and Services Catalogue*, National Security Agency, available through Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402, (202) 783-3228**

This document is published yearly, with updates distributed to subscribers every quarter. It is intended to assist users in selecting information systems security products compatible with their needs. For each of the evaluated or endorsed products, manufacturer information and points of contact are given.

***Initial Lessons Learned During the Military Airlift Command Command and Control Multilevel Security Project*, Defense Information Systems Agency MLS Technology Insertion Program Office, 1991**

This report provides a high-level examination of issues involved in the MAC C2 MLS project. Lessons learned cover requirements identification, the availability of MLS products, and the applicability of relevant policies and standards to MLS integration projects.

***IBM PC and Macintosh Networking*, Stephen L. Michel, Hayden Books, 1988**

This book has its limitations – it deals with Macintosh and MS/DOS systems and TOPS and Appleshare networks almost exclusively – but it does provide an excellent elementary discussion of file formats, file transfer, and networking. In addition to describing links between Macintosh and DOS platforms, it can help users of each type of computer better understand the other one.

***IEEE Network magazine*, IEEE Communications Society, (201) 981-0060**

This magazine is produced by and for engineers with experience in networking. Its presentation is scholarly and most articles go into considerable technical detail; however, some good survey articles, such as "What Managers Really Need to Know About LANs" (November 1989), are included.

***LAN Times* magazine**

This biweekly publication covers local area networking, enterprise networking, product highlights and comparisons, and industry news and analysis.

***Network Computing Magazine*, free to selected users, CMP Publications, 600 Community Drive, Manhasset, NY 11030-9789**

This magazine provides a wide range of information relevant to both the communications and information processing subsystems; a recent issue covered modems, microcomputer operating systems, and network protocols.

***Networking Management* magazine, available free from the publisher, PennWell Publications, Circulation Department, Box 2417, Tulsa, OK 74101-2417**

Offering "solutions for MIS, voice, data, and video professionals," each issue this magazine provides industry news, a technical overview of a selected topic, commentary, and a variety of other features.

***Network World* newspaper, (800) 622-1108**

This newsweekly addresses industry trends in telecommunications, data communications, and local networking, as well as management strategies and product and services highlights.

Briefing and Display Subsystem Information Resources

***AV Video* magazine *and Computer Pictures* magazine, Montage Publishing, 25550 Hawthorne Blvd., Suite 314, Torrance, CA 90505**

AV Video addresses a broad range of technical issues relevant to the briefing and display subsystem. The bimonthly *Computer Pictures* specializes in information and presentation graphics, video, and CAD. It provides no-nonsense information that would be valuable to command center personnel with briefing development responsibilities.

***Broadcast Engineering* magazine, mailed free to "qualified persons" in the engineering profession and those working in video facilities, P.O. Box 12902, Overland Park, KS, 66212-0902**

Although many articles are highly technical, this monthly magazine provides thorough coverage of the industry and explores video communications and teleconferencing.

***Communication Industries Report*, International Communication Industries Association, 3150 Spring Street, Fairfax, VA, 22031, 703/273-7200**

The ICIA, a nonprofit trade association, publishes the Communications Industries Report, which addresses developments in both the government and commercial technology arenas; sponsors an annual trade show; and distributes various special products. These products are not strictly communications-oriented; one of them, a poster-format market survey of large-screen display products, is especially recommended as a BDS reference.

***Government and Military Video* magazine, free subscription available from P.O. Box 0513, Baldwin, NY 11510-9830**

Geared toward federal, state, and military video professionals, this monthly publication includes equipment reviews, theory, and real-life technology applications.

***Presentation Products* magazine, free to readers who complete a questionnaire, P.O. Box 5306 Pittsfield, MA**

This monthly publication covers all aspects of creating, producing, and delivering presentations. It provides product reviews, product focus articles, information on products at work, and feature stories related to presentation topics.

***Videography* magazine, PSN Publications, 2 Park Avenue, Suite 1820, New York, NY, 10016**

This magazine covers video production, technology, and applications. The multimedia and technology features are a good reference for command center a/v personnel to use in designing briefing and display systems within a command center.

Facilities Subsystem Information Resources

DoD 4270.1-M, *Department of Defense Construction Criteria Manual*

This manual assists users in determining space requirements, appropriate construction types, finishes, etc. It is the main reference for military construction criteria.

DG 1110-3-122, *Design Guide for Interiors*, U.S. Department of the Army, Office of the Chief of Engineers, December 1982

A practical "how-to" handbook on how facility interiors can be successfully improved through various types of upgrades. It addresses topics including lighting, flooring, and wall finishes.

Rush, Richard, *Building Systems Integration Handbook*, Wiley and Sons, New York, 1985

This book discusses how the various facility subsystem elements interact. Chapter 6 describes how a successful "systems integration" approach impacts the performance quality of a facility.

***Human Factors Design Handbook*, Wesley E. Woodson, McGraw Hill Book Co., 1981**

This very detailed reference cannot take the place of a human factors expert, but it can help the average reader become familiar with the terminology and issues involved in making a building or space usable and comfortable. (Borrowing the book from a contractor or consultant may be best for the casual user, since its level of detail is more appropriate to facility engineering professionals.)

***Time-Saver Standards for Architectural Design Data*, John H. Callender, McGraw Hill Book Co., 1982; and *Time-Saver Standards for Building Types*, John H. Callender, McGraw Hill Book Co., 1982**

These two references define terms related to facility design and describe the various components of common spaces and buildings. They provide standard values for distances, dimensions, lighting levels, sound transmission, finish types, and other facility aspects.

PART 4. COMMAND CENTER IMPROVEMENT PROCESS EXAMPLES

INTRODUCTION

In a learning experience, having all the facts is not always enough to ensure mastery of the topic or proficiency in a new skill. Many people learn best by observing how other people accomplish a particular task. Not only can the observer see how others approach the work to be done, but he or she can also take note of mistakes or inefficiencies. When the observer's turn to practice a new skill comes around, the "lessons learned" by watching will prove beneficial.

Few command center personnel have the luxury of watching over the shoulder of a project planner or manager. Often an action officer is given project management responsibility suddenly, when a problem comes to the attention of someone with the authority to order a correction. The person who handled the problem previously may have moved on to a new assignment elsewhere. Even if the action officer has some technical background to bring to bear on the problem and knows that contractors, vendors, and technical consultants are eager to provide equipment and services, fewer advisors and publications are available to help the action officer tackle questions such as:

- What exactly is the problem I am supposed to solve?
- If there are several deficiencies causing this problem, how do I determine which ones must be resolved, and in what order?
- Once I know my requirements, how do I start to find equipment to satisfy them?
- How do I make sure my organization gets what it needs, not just what somebody happens to like?
- Why should I be concerned with how other organizations are being upgraded?
- How do I get support for my plans?
- How can I contact somebody who has already dealt with this problem?
- Why should I look for a partial solution if the perfect answer isn't available or affordable?
- How can I sort through vendor's claims and determine how good their products really are?
- Why should I involve users, technical experts, or contractors?
- How do I handle training, maintenance, and cut-over to the new system?

The earlier chapters of this volume of the CCDH answer these questions theoretically, providing various procedures and policies the planner should follow. This section, in contrast, allows the reader to learn by example. It consists of vignettes highlighting real-world planning and management as practiced by various organizations in the command center community. This section does not reveal what equipment a particular organization purchased, or how much it cost, or who installed it. Using that type of data is risky, if the planner simply imitates what was done elsewhere and does not respond to the requirements of his or her specific situation. Instead, this section helps the reader arrive at answers to "how" and "why" questions, such as those listed above. The new ideas, techniques, and confidence these process examples may inspire will prepare the user to look further in the CCDH, and elsewhere, for the technical building blocks of command center upgrades.

Note: Due to the recent addition of this section to the CCDH, few "process examples" are available in this edition. It is anticipated that several dozen will eventually be developed; input from readers for this section is welcome.

EQUIPMENT ACQUISITION: COMPARISON-TESTING CRT PROJECTORS

Surprised by the performance of a CRT projector that was installed as a backup to a suite of troublesome laser projectors, the Strategic Air Command decided in 1989-1990 to switch to an all-CRT projector configuration in its command center. Although they wanted to replace the laser projectors as soon as possible, the coordinators of the SAC upgrade took the time to conduct a thorough evaluation of available products to ensure the model they purchased would best suit SAC's needs.

With input from users at SAC, hardware and software maintenance personnel, logisticians, and audiovisual staff, they established a list of requirements. They also consulted commercial technical experts and government experts from DISA and other command centers. The resulting requirements addressed issues of image quality, technical quality, maintainability, interface compatibility, and price. Based on these requirements, forms were developed to measure technical characteristics and to record product information.

SAC then proceeded to evaluate projectors in a series of "shoot-offs." A preliminary shoot-off at an audiovisual technology convention allowed SAC personnel to examine every video projector on the commercial market. The manufacturers of those products that were at least minimally capable of meeting SAC's requirements were invited to shoot-offs in the command center.

In the command center environment, audiovisual experts conducted preliminary tests of each projector using the previously defined requirements. Compatibility with the RS232 interface was noted as each projector was installed, and the projector's output was measured against established standards for light output, brightness, image uniformity, contrast ratio, resolution, grey scale, and color accuracy. An image generator and light meter were used to measure each projector's performance.

Next, formal shoot-offs were conducted. The purpose of this round of tests was to compare image quality on a subjective basis. A testing group of SAC personnel compared images projected four at a time onto adjacent screens in the command center. The images were taken from a variety of sources, including videotape, off-air television, videodisks, and PC workstation displays. With no knowledge of which particular products were being tested, the test group rated the apparent brightness, color rendition, crispness, clarity, and overall quality of each image. The evaluation forms used by the test group first asked each person to rate the overall image quality from one to ten, and then directed them to consider particular characteristics. Participants were encouraged to make additional comments about image quality either verbally or on the form.

The keys to success in the case of SAC's projector shoot-offs were:

- A thorough, detailed **requirements definition** phase, in which both technical experts and end users of the equipment participated
- **Application of the requirements** to all available products to narrow the field, so that the final evaluations focused on qualified contenders only
- Balanced emphasis on **subjective and objective evaluation** criteria in the shoot-offs. As in the requirements definition phase, SAC relied both on technical experts, who measured the quality of the devices, and on typical end users, who evaluated the projectors' performance.
- **Testing in the command center** environment using an array of typical images generated by SAC.

MANAGEMENT ISSUES: AN OPERATOR'S VIEW OF THE COMMAND CENTER UPGRADE PROCESS

The author of the following section, LCDR Mark Stiffler, was formerly assigned to USLANTCOM and was involved in several successful enhancements to USCINCLANT's C2 processes. His observations about upgrade management are based on both his user-level experience at LANTCOM and his current perspective as a member of DISA's CCIP staff, in which capacity he provides technical and programmatic advice to various commands engaged in upgrades.

The processes that ultimately result in an upgrade to a command center vary from one command center to the next. Because each organization operates under a combination of the regulations of its sponsoring Service, applicable JCS and DoD regulations, and such local directives as it considers appropriate, the dynamics of the upgrade process are substantially different throughout the command center community. Some of this variation is justified by different missions, but for the most part no real standardization of the upgrade process has been achieved. The range of possible approaches is wide:

- One major CINC has in place detailed "vision" documents that outline the direction the command plans to take regarding future capability; a detailed requirements study; and broad-based, powerful management boards to assist it in reaching its goals.
- Another major CINC is more ad hoc, operating with a requirements branch and a few traditional ADP planning documents, which give little if any real guidance to the command center upgrade process.

Despite this variation, there is an emerging process used by some commands that must be described, if only as a reference; however, to understand it you need to look at how older, established processes work. In these the technical people within a command who are capable of designing upgrades to command centers typically reside within the J6 staff element. They support a variety of command, control, communications, and general ADP requirements. Most of these requirements are accepted or rejected depending on the internal policies of the command; however, in a traditional system the user generates the requirements. An example might involve a command center supervisor who determines that his briefing slides are not sufficiently graphic to convey the information he desires. If he knows of a graphics program that is capable of solving the problem, he may write a memo to the requirements office in J6 asking to obtain the capabilities that he supposes are within the program. The requirements office will determine whether there are other issues that bear on the request, such as standardization, capability with existing hardware, funding, training, projects already in the works, etc..

For a larger issue, the user may highlight deficiencies in his ability to accomplish the stated mission of the command. A paper identifying the critical elements of the mission that are not being adequately accomplished is produced and alternative solutions are discussed and evaluated. Depending on the costs of a proposed solution and the governing directives followed by the command, a type of "cost/benefit" study is then produced, resulting in a decision paper. This analysis is usually independent of funding, and it is possible to get full approval for a project but no funds to execute it. In one possible scenario, the command center supervisor has determined that a LAN is needed to assist watch officers in the conduct of their mission. The ability to adequately develop and present action alternatives to key decision makers is currently crippled by the need to bring together diverse pieces of information from different computer systems onto one briefing and display system. In rapidly changing situations, the existing system cannot keep up with the information demands of the decision makers. To initiate the process of solving this problem, the command center supervisor creates a "Mission Element Needs Statement" which shows the need and lists proposed solutions. This is sent to the requirements organization. From there the process proceeds.

This scenario contrasts with the approaches of some modern organizations that are moving to an "ongoing" process that is actually a near-real-time partnership between technically knowledgeable personnel, requirements analysts, and operations personnel. Together, all these personnel work to create a medium- and long-term plan for command and control that lists desired capabilities and anticipated future requirements and operating constraints. From this plan, a list of requirements is drawn and concrete upgrades are planned to satisfy those requirements. The advantage of this approach is that operators who are unfamiliar with new technologies work directly with technical personnel, who under more traditional processes seldom see the full operational aspects of their technical decisions. As a result of the partnership, the operations personnel end up with more realistic requests and the technical personnel end up designing more usable solutions. In some cases, problems are uncovered and avoided that neither could have detected if working independently. That is to say, each member of the process provides input based on his or her own experience, as well as in response to input from the other members. Frequently, at the start of a project, the participants have

diverse views; through the partnership approach, their perspectives are gradually drawn together, resulting in a stronger solution that is widely supported throughout the staff elements of the command.

Concurrent with the growth of the process just described there has grown a need to look outside the command to anticipate "top-down-directed" systems that are not compatible with existing command and control facilities. Some command centers currently have more than 8 separate C2 systems that cannot interoperate. Service and DoD agencies developing new systems frequently do not consider the technical environment in which these systems will have to operate. As a way to cope with these diverse systems, command center personnel are increasingly turning to the DISA CCIP office for assistance. CCIP personnel help with integrating systems that are currently installed and provide guidance for future upgrades.

In summary, there is not single "process" for command center upgrades. The most common thread that runs through many CINCs' individualized programs is the framework provided by the MROC, command center system architecture, and framework TA/CE developed by DISA. Some variations in how command centers are maintained and enhanced will always exist as a result of different Service and local regulations, human and monetary resources, and personal styles, but relying on the experience of other commands and the assistance of other organizations to solve common problems can only improve the ultimate results.

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JCS Pub 6, *WWMCCS Objectives and Management Plan*, Joint Staff.

LIST OF ACRONYMS

ADP	Automated data processing
AM	Acknowledgment Memorandum
APES	Activity Personnel Equipment Schedule
BPPBS	Biennial Planning, Programming, and Budgeting System
BSSC	Battle Staff Support Center
C2	Command and control
C4S	Center for Command, Control, and Communications System
CAT	Crisis action team
CCDH	Command Center Design Handbook
CCIP	Command Center Initiatives Program
CINC	Commander-in-chief
CO	Commanding officer
DISA	Defense Information Systems Agency, formerly DCA
DoD	Department of Defense
DPI	Data processing installation
DTS	Demonstration and Technology Survey
ECP	Engineering change proposal
HVAC	Heating, ventilation, air conditioning
IPL	Integrated priority list
JCS	Joint Chiefs of Staff
JTC3A	Joint Tactical Command, Control and Communications Agency
MILCON	Military construction
MLS	Multilevel security
MROC	Multicommand Required Operational Capability
NDI	Non-developmental item
PE	Preliminary estimate
PMP	Program management plan
POC	Point-of-contact
POE	Post-occupancy evaluation
POM	Program objectives memorandum
PPBS	Planning, Programming, and Budgeting System
ROC	Required operational capability
RS	Requirements submission
SAC	Strategic Air Command
SCN	Systems development notification
TA/CE	Technical assessment/cost estimate
WWMCCS	Worldwide Military Command, Control and Communications System

GLOSSARY

Acknowledgment Memorandum. The vehicle by which the Joint Staff acknowledges receipt of the Systems Development Notification and notifies other agencies that may be affected of a proposed acquisition, development or change, along with validating the initial requirement. This will occur typically within 30 days following the completion of any necessary technical evaluation.

Activity logs. A process used for comprehensive documentation and subsequent evaluation of operational activities. It is used to collect detailed task/activity information, along with listings of furnishings and equipment used during normal or crisis operations, to identify deficiencies and make improvements where possible.

Command center. A facility from which a commander and his representatives direct operations and control forces. It is organized to gather, process, analyze, display, and disseminate planning and operational data and perform other related tasks.

Command center community. The collection of staff, personnel, and associated work units within command centers; specifically, those of approximately forty organizations that include the NMCS, U&S commands, subunified commands, and component commands.

Command Center Initiatives Program. The program provides technical and engineering support to the unified and specified commands, their components, the Services, and other DoD command centers. The objective is accomplished through the application of state-of-the-art technologies to command center problems, promoting greater interoperability among the command centers of the NMCS, and by reducing costs through the application of common command center architectures and technologies where appropriate.

Command center mission. The task and purpose assigned the command center, which clearly indicate the action to be taken and the reason for the action(s) taken by the command center and its staff.

Common use spaces. Spaces in the command center that are not part of the specific space for which requirements are developed in the facility delivery process but are needed by personnel to perform the functional or mission-related needs of the space.

Concept design review. A review process of the concept and basic design of a project. It is performed by those responsible for project management. The review occurs within a relatively short period of time, approximately two weeks. The review is primarily focused on the functional and technical aspects of the facility, and the review team must check the facility design for compliance with the functional requirements information.

Configuration control procedures. During facility modification, construction, or software development that ensures the impact of change on other elements of the command center are foreseen and accommodated.

Configuration management. A process the provides for the documentation of historical configuration records, a database of current system configuration, the ability to monitor or track configuration changes, and monitor future plans and expected changes. It supports improved management of command center changes, improves system descriptions, provides a current baseline of information for engineering plans and reduces effort to initiate and complete engineering projects.

Engineering change proposals. Proposed changes to a facility modification, construction, or software development that should be recorded with a justification for each change to ensure controlled project management.

Facility delivery process. A process that is intended to provide a vehicle by which improvements to facilities - new construction or renovation - or equipment can be realized. The process is applicable to all major projects exceeding certain dollar limitations throughout the Department of Defense.

Facility functional requirements. Statements, provided during the facility delivery process in the acquisition and integration plan, about what is needed in a facility to effectively support the activities, people, and equipment it will contain. Usually these are qualitative statements supported by data about a facility's occupants, their mission, and their use of the building, but do not describe the design solution.

Functional area. A space within a command center where specific mission functions are effectively accomplished.

Functional spaces. The standard thirty-eight spaces comprising a command center that are defined in terms of the tasks they support.

Hardware. A generic term dealing with physical items as distinguished from its capability or function such as equipment, tools, implements, instruments, devices, sets, , components, and parts. The term is specifically used in data automation to mean physical equipment or devices forming a computer and peripheral components.

Parallel or hot switch-overs. A situation where new systems being installed run in parallel operation with the older systems being replaced to ensure continuity of operation during the change over.

Living document. A document that remains current and viable for operational use by undergoing periodic updates to maintain current all technology and policy information and to remain valid.

Multilevel security. The simultaneous processing of information at several levels of classification without the possibility of compromise.

Operational environment. The command center environment that includes operations and procedures, system and equipment support for operations, and physical facility support for operations.

Planning, Programming, and Budgeting System. A continuous cycle that allows funding requirements to be articulated, developed, adjusted, and fulfilled over a three-year period of time.

Post-occupancy evaluation. A phase during which the evaluation of the acquisition and integration of systems and equipment, and the construction and occupancy of the new or newly modified command center occurs following completion of the project.

Program management plan. A tool that provides coordinated management of a project to ensure that all activities occur on schedule, within budget, the project achieves the required increased capability. It outlines the goals and objectives of the project, outlines project goals, and provides a framework for problem solving and a systematic approach for rational program management.

Rapid development process. A specific management approach that is intended to field systems sooner than traditional methods, to lower system costs and increase user satisfaction by responding directly and more rapidly to problems perceived by the user.

Rapid prototyping process. A process through which a product or procedure is created in response to preliminary requirements and tested to discover whether the requirements were sufficient to produce a workable solution.

Required Operational Capability. A formal request document on which senior authorities base approval decisions. It examines all aspects of the command center need and provides a statement of the requirement that gives background to the identified required capability, a justification of the required capability documenting the impact of the capability on the mission of the command center, the essential characteristics of the capability, and associated considerations that may result from the implementation of the capability.

Software. A set of computer programs, procedures and associated documentation concerned with the operation of a data processing system, e.g., compilers, library routines, manuals, circuit diagrams.

Stovepipe systems. Single purpose devices engineered to provide individual solutions to each problem that arises in the command center.

Systems Development Notification. Formal documentation that is required to notify the appropriate approval agencies of a systems improvement action. The notification provides an opportunity for complementary planning by supporting activities and permits notification to the submitting service or agency of any known conflicts or impact upon the planned proposal.

Technical Assessment/Cost Estimate. The major product of the process to define a program and determine its requirements, following the approval of a required operational capability document. The TA/CE is the initial statement of the systems and facility requirements necessary to satisfy the operational capabilities set for in the ROC. It is the phase during which the project is realized through schedules, hardware, software, physical or facility modifications, and budget needs; it steps beyond the conceptual design.

Tiger team. A team of technical experts that analyze a command center deficiency and provide recommendations that if implemented will contribute to a solution of the identified problem(s).

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APPENDIX

FACILITY DEVELOPMENT PROCESS FORMS FOR REPRODUCTION

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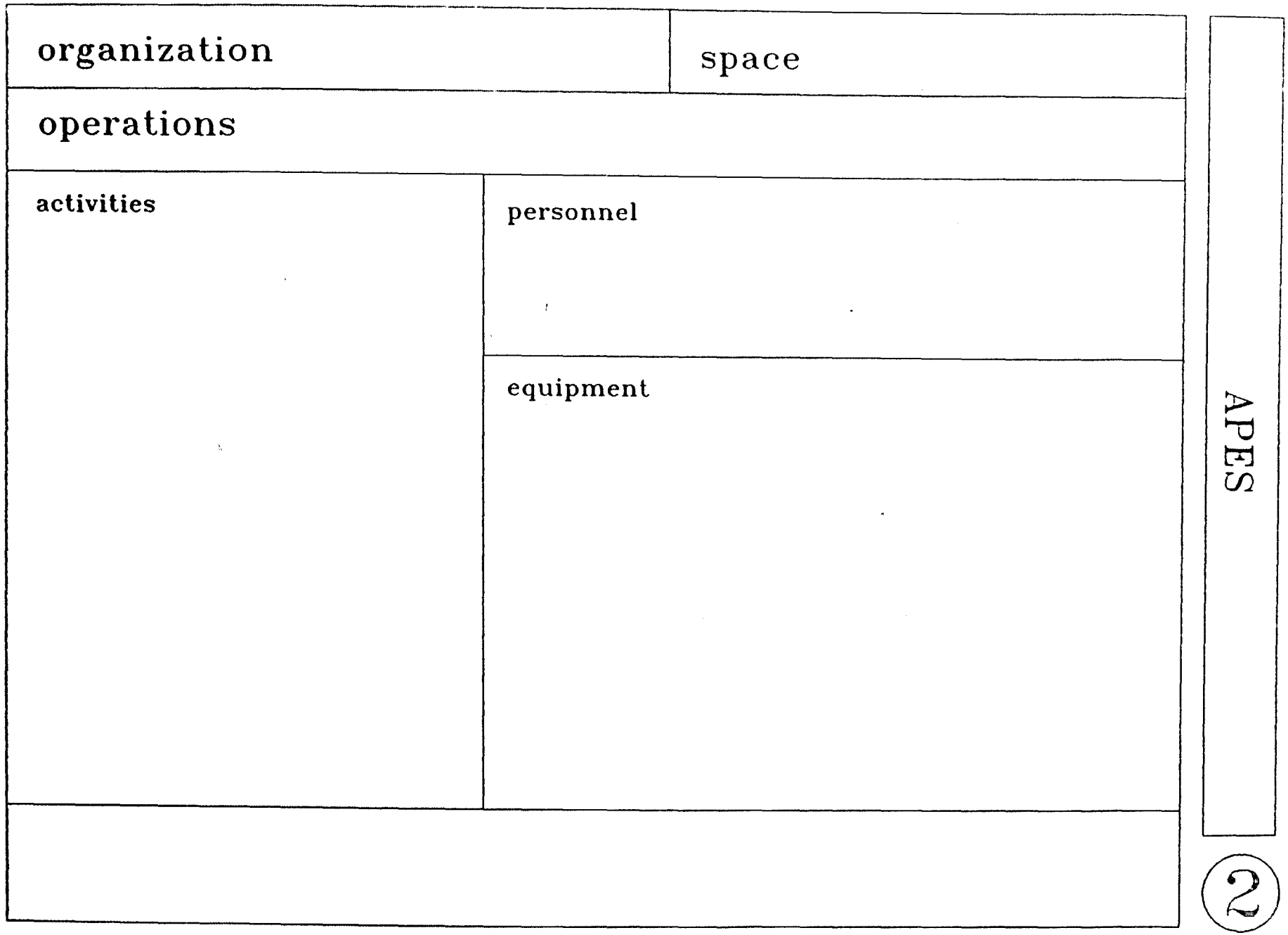
1

organization

contact personnel

function

operations


organization
space
operations
activities
personnel
equipment
APES
2

Requirements

4

operations		space	
code	requirements	code	requirements

needs codes
N – necessary (lack of seriously impairs function)
I – important (lack of impairs function)
H – helpful (lack of slightly impairs function)

purpose codes
1 – activity of function
2 – health or safety
3 – morale
4 – security
5 – equipment of performance
6 – other

common use spaces

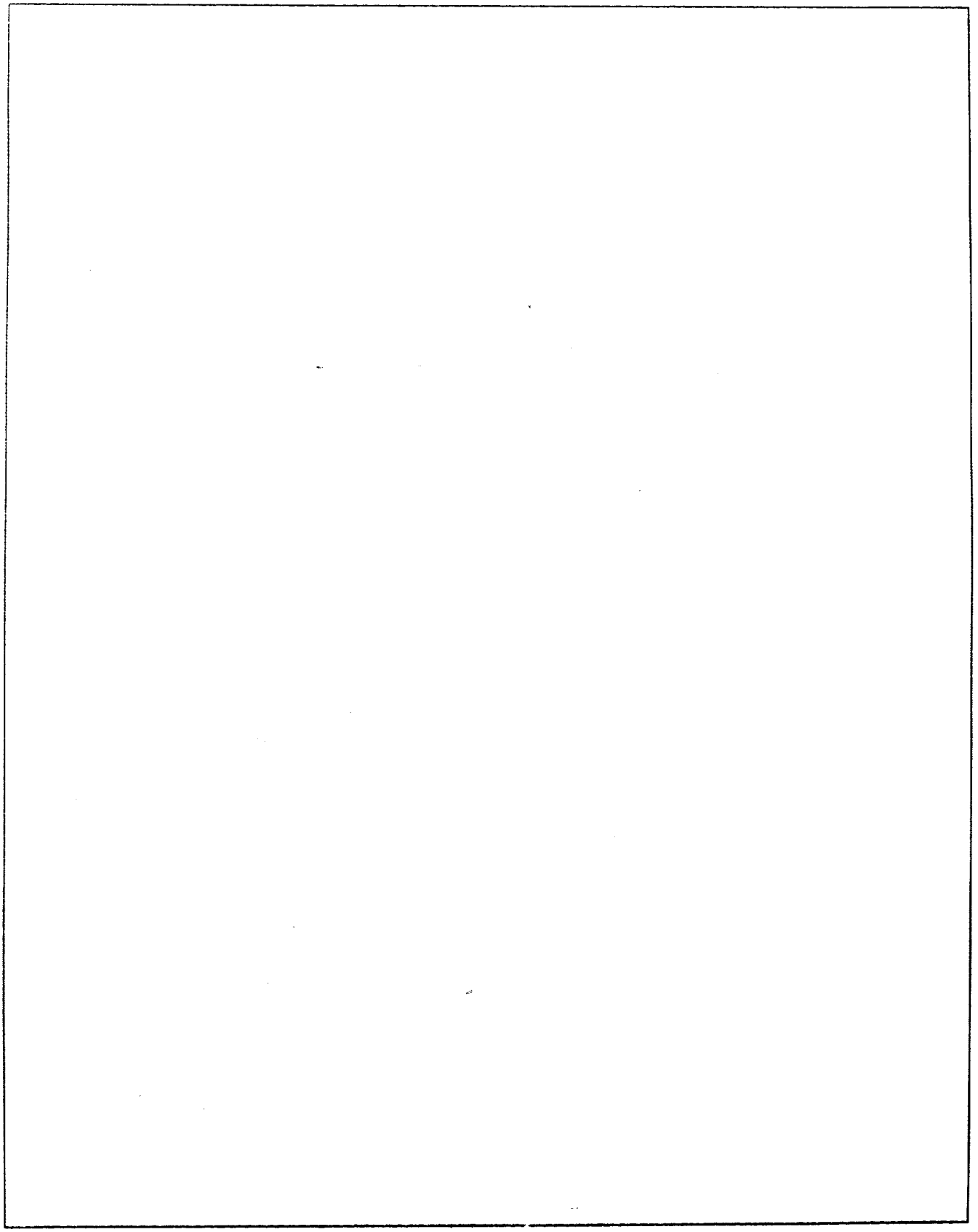
space type:	how often used:	for how long:	number of people:

forecast

nature of change:	impact on: (space type, quantity, requirements)	date anticipated:

Functional Relationships / Layout

1



Spaces and Adjacencies

2

Detailed Functional Requirements

3

space

organization

adjacent spaces

requirements

square feet

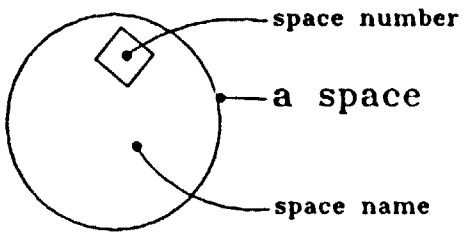
personnel

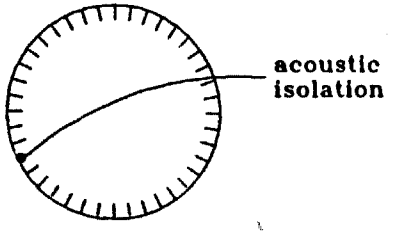
Equipment Data

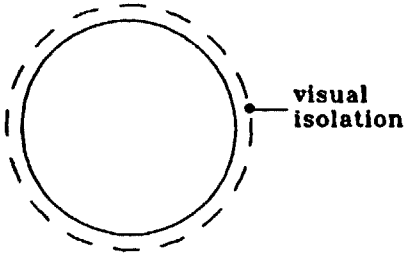
4

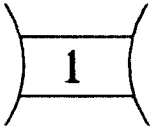
organization		space											
equipment name	ape	conditions generated					conditions required						
		noise	air cond.	heat	other	explanation	air cond.	vent	light	elect.	other	explanation

Legend

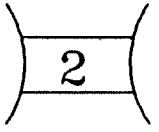




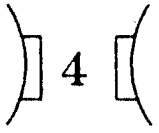




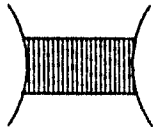
spaces must be adjacent



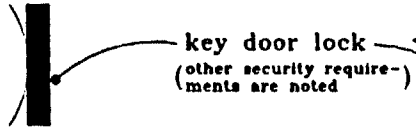
close o.k., but adjacency preferred

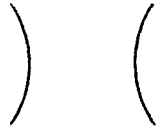


spaces must be far apart

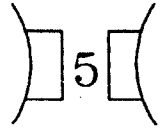


visual access required





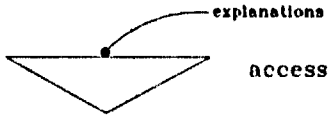
no relationship
(3 implied)



different buildings



main entrance to a group of spaces belonging to one organization



access to a space

Project Review Comments

Type:
Concept: ☐
Final: ☐
Other: _____ ☐

Date: _____

Project: _____

Location: _____

Year: _____ L.I. _____

Reviewer

Name: _____

Organization: _____

Comment Number	Drawing / Page / Space	Comment	Action

Project Review Comments

Date: _____ Page ____ of ____

Project: _____

Location: _____

Reviewer

Name: _____

Comment Number	Drawing /	Page / Space	Comment	Action

Defense Information Systems Agency

Joint Tactical Command, Control and Communications Agency

COMMAND CENTER DESIGN HANDBOOK

Volume 2:
Command Center Spaces

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Note: Each of the 38 generic core and support spaces use three figures to describe graphically the recommended configuration of equipment and facility items involved.

For each core space the graphics are usually on the following pages:

Plan of Functional Workstations page 6
Isometric of Total Space page 7
Reflected Ceiling Plan of Total Space page 8

For each support space the graphics are usually on the following pages:

Plan of Functional Workstations page 4
Isometric of Total Space page 5
Reflected Ceiling Plan of Total Space page 6

PART 1 - INTRODUCTION TO VOLUME 2

PART 1.
INTRODUCTION TO VOLUME 2

OVERVIEW

Experience has shown that command centers must not only be flexible and able to react rapidly to changes in missions and tasks stemming from political and military developments, but must also accommodate and capitalize on technological advances as they occur. Potential changes in command center missions and equipment require that the building spaces be readily and economically adaptable. Also, these spaces (where specific command center activities occur) must be continuously mission-responsive. Parts 2 and 3 contain two categories of command center spaces:

- **Part 2: Core.** Where command center mission function tasks are performed (e.g., Indications/Warning Center)
- **Part 3: Support.** Where activities are performed that are essential to sustain the mission function activities of core spaces (e.g., Telecommunications Center).

Improvement project planners and designers will require the types of information contained in Parts 2 and 3. After a functional requirement has been identified, Parts 2 and 3 can be used to determine the total facility area and the individual spaces required for operations. Next, optimal workstation areas are shown to assist in allocating floor space to each organizational unit. Finally, individual workstations can be designed based on the requirements of an operator for communications, information processing, and briefing display systems.

For acquisition management purposes, information is provided to facilitate the development of a tool for the continuing evaluation of the facility in a format that describes optimal workstation requirements, criteria, and layouts. Existing spaces can be improved to more optimal conditions through a series of small-scale projects. Users interested in developing project design should attend to the criteria, guidance, building components, and systems information for each space, and to the prototype composite space layout at the end of each space type section.

The space-by-space information in Parts 2 and 3 is formatted as seven types of data (see Figures 1-1 and 1-2):

- **Function.** Statement of the overall mission-driven requirement for housing the space in a command center.
- **Operations.** Data indicating the types of work performed in the space in support of the command center mission.
- **Activities/Personnel/Equipment.** The specific operations, and identification of associated operator personnel and equipment.
- **Requirements.** Statements about what characteristics the building must have in order to provide optimal occupant/environment interaction.
- **Criteria.** Statements developed directly from the requirements list that provide quantitative measures to assist in determining the proper design for a responsive/supportive environment.
- **Commentary.** The rationale used in establishing a criterion or the basis of a qualitative criterion measure. Also, a reference to another part of the CCDH for additional information.
- **Guidance.** Statements, sketches, and diagrams providing advice about communications, information processing, briefing and display, and facility systems, based on design experience and case studies related to similar functional areas.

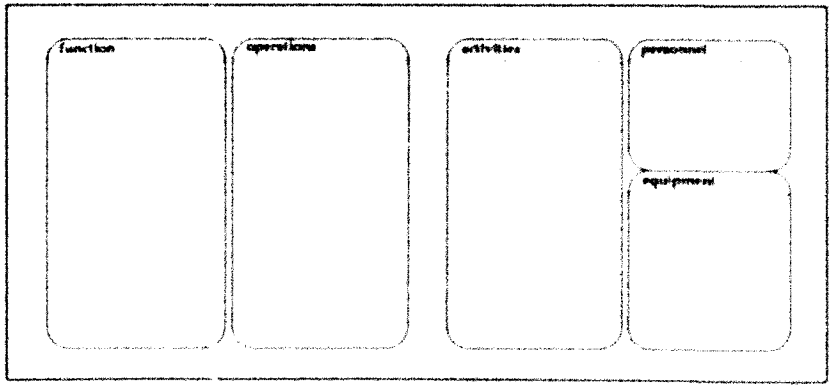


Figure 1-1. Background Information About a Space

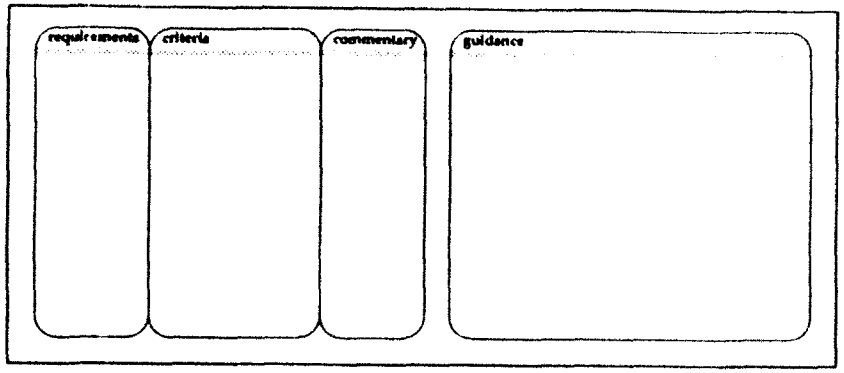


Figure 1-2. Generic Information About a Particular Space for Evaluations, Planning, Programming, or Design

For each space type, a space layout diagram is presented in the guidance section to portray the desired optimal adjacencies of all workstations within the space. All information contained in the seven categories is generic. When developing the material, information about each of the separate spaces was generated in terms of the operations that determine the activities, personnel, and equipment required to accomplish a specific function. Next, requirements and criteria for the space were developed that will enable the building to support the activities at the occupant worksations. Finally, planning concepts in the form of guidance related to specific command and control systems for each operational area were generated. Thus, the requirements, criteria, and guidance provide "optimal information" about a functional space, based on the mission-driven functions. Relevant information about operations and maintenance (O&M) practices was obtained from military and industry sources, researchers, and current periodicals and research literature. The material has been integrated into a format for each functional space so that all information can be viewed together, starting with the operations related to a particular function and ending with a layout sketch with the building and equipment components and systems recommendations. The information content and format of Parts 2 and 3 is designed to permit ready access and facilitate incorporation into planning, programming, and design documentation.

GENERIC COMMAND CENTER FUNCTIONS

The importance of recognizing a command center as a system, and of addressing command center improvement in a systematic fashion, cannot be overstressed. The logical first step in any command center improvement, therefore, is to examine the functional aspects of a proposed project in order to determine its impact on the command center system. In order to assist the user in this functional examination, the following pages present a set of nine statements which, when viewed in terms of their activities and specific tasks, provide a comprehensive summary of command center functionality. These nine functions were derived from the functions listed in JCS Pub 19 and the *WWMCCS Current System Description* and are listed below:

- Situation Monitoring
- Force and Resource Status Monitoring
- Situation Assessment
- Operations Planning and Scheduling
- Decision Making and Support
- Order and Mission Instruction Preparation and Dissemination (and Report-Back)
- Employment and Execution of Forces (Initial and Reconstituted)
- Force Employment Monitoring
- Hostilities Termination and Negotiation

As shown in figure 1-3, each of the functions is subdivided into activities (e.g., "1a" denotes activity "a" under function #1) which are arrayed in the column directly below the function. Tasks performed during each particular activity are shown directly below the activity. They describe steps that command center personnel would take to perform an activity. Tasks identified in the following pages serve only as examples because the actual tasks performed may be different in each command center.

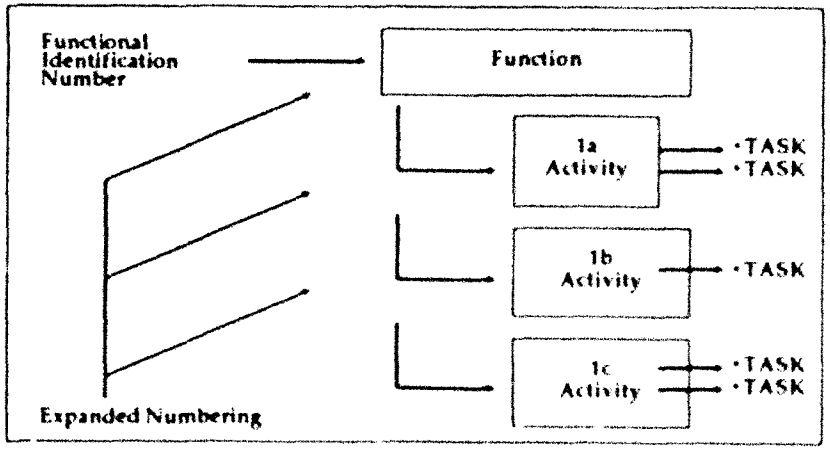


Figure 1-3.
Functional Decomposition

It must be clearly understood that these are generic functions, activities, and tasks. As such, these are representative of what any command center might be expected to do. They must be viewed as no more than a template for use in developing mission requirements for C3I support into command center system capabilities for a specific command.

1. SITUATION MONITORING

SITUATION MONITORING includes the collection and aggregation of information about events, actions, and situations of national interest. The status of political, economic, and diplomatic activities (as well as acts of nature) contributes to this worldwide monitoring process. This includes U.S., Allied, and enemy military and civil events and operations worldwide, and also includes the monitoring of strategic and tactical warning indicators. Situation Monitoring activities and tasks are:

1a. Receive, maintain, integrate, and display data from external systems, e.g., State Department, intelligence community
- Identify and select sources for data collection. Access selected sources, select data from the sources and transport the data to the local workplace. Process the data by reformatting, filtering, editing, etc.; integrate with other/same source data; and display. Maintain the data and keep current.

1b. Monitor status of global actions, critical events, natural disasters, crisis areas, political/diplomatic/economic developments, non-U.S. military operations, etc.
- Identify and select sources for data collection. Access selected sources, select data from the sources, and transport the data to the local workplace. Process the data by reformatting, filtering, editing, etc.; integrate with other/same source data; and display. Maintain the data and keep current.
- Determine if a problem exists and present a briefing describing the problem and potential ramifications.

1c. Monitor environmental conditions
- Obtain and display environmental data
- Analyze environmental data and identify problem areas. Brief potential ramifications.

1d. Maintain locations and contacts with key CINC and allied personnel
- Determine locations of key personnel (NCA, Joint Chiefs of Staff, MILDEP, Allied government, Allied military, etc.) and update the key personnel location files.
- Display the set of key personnel locations and how to contact

1e. Monitor U.S. policies, rules of engagement (ROE), treaties, agreements, etc.
- Assemble and update U.S. policy, treaty, etc., files.
- Display the information.

1f. Provide aircraft and missile warning
- Identify and select information sources.
- Establish and maintain communications sources.
- Determine thresholds for warning and set alarms for conditions above the thresholds. Conduct periodic tests of the alarm system.
- Establish and maintain threat discrimination criteria.

1g. Identify nuclear detonations
- Identify and select information sources.
- Establish and maintain communications with the sources
- Determine thresholds for nuclear radiation and set alarms. Conduct periodic tests of the alarm system.

1h. Direct and task surveillance systems
- Select data from the following functions: Situation Monitoring, Force and Resource Status Monitoring, and Decision-Making and Support
- Determine surveillance requirements such as area to be covered, type of surveillance (photo, electronic, etc.), timeframe for surveillance, and reports (type of report, frequency, and address list)
- Prepare, coordinate, release, and transmit tasking directives
- Maintain a transmit/receive log

2. FORCE AND RESOURCE STATUS MONITORING

FORCE AND RESOURCE STATUS MONITORING includes the monitoring of U.S military active and reserve organizational peacetime readiness, combat sustainability, and other status information such as unit location, resources, composition, and readiness level. Similar information is monitored for designated Allied and enemy forces and resources (F/R), as applicable, worldwide. Force and Resource Status Monitoring activities and tasks are:

2a. Monitor, determine and display the status and readiness of all U.S. F/R (including active and reserve elements) and non-U.S. F/R worldwide (including nuclear forces status and weapons)
- Monitor the status and readiness of U.S. and non-U.S. F/R to include strategic, theater, conventional, and reserve F/R. Identify, select and access sources for data collection. Transport the data to the local workplace, process the data by reformatting, filtering, editing, etc.; integrate with other/same source data, and display. Maintain the data and keep current.

2b. Identify and display unit resources, facilities, communications, and weapons system characteristics and capabilities, planning factors, and performance data
- Collect data on strategic, theater, conventional, and reserve F/R; military (airfields, naval joint, etc.) and civil facilities; military (strategic, tactical) and civil U.S. and non-U.S. communications systems; strategic and tactical system characteristics and capabilities of U.S. and Allied forces, planning factors; and systems, equipment, facilities, and unit performance data.
- Identify, select and access sources for data collection. Transport the data to the local workplace; process the data by reformatting, filtering, editing, etc.; integrate with other/same source data, and display. Maintain the data and keep current.

2c. Identify critical logistics resources
- Identify and assess logistics capabilities for transportation, material procurement, and other actions critical to the support of planned or anticipated operations.

2d. Identify the location and status of airlift and sealift assets
- Identify the location and status of U.S and Allied airlift and sealift assets (both military and commercial).

2e. Assess force operational readiness capability and availability; identify the deployable status of designated forces
- Assess the operational readiness and availability of U.S forces (Army, Navy, Air Force, Marines, and Coast Guard) and Allied forces. Display readiness and availability data, and designate U.S and Allied forces for deployment.

3. SITUATION ASSESSMENT

SITUATION ASSESSMENT includes analysis of information by monitoring functions, assessing events and indicators of interest, and determining the relationships of and impacts on existing and projected U.S *military posture*. It includes evaluation of all F/R capabilities worldwide, strategic and tactical situation assessment and warning, and threat and attack assessment, as appropriate. Situation Assessment activities and tasks are:

3a. Assess U.S. F/R status relative to non-U.S. F/R status
- Obtain U.S. and Allied F/R status information and data. Once enemy F/R data have been obtained, a comparison and evaluation can be performed, and results displayed.

3b. Determine military implications of intelligence indicators and enemy order of battle (EOB)
- Identify and evaluate intelligence and EOB information.
- After determining and identifying sources for data, query and select it from the source data. Obtain information and display it.

3c. Assess events relative to U.S. policies, treaties, interests, etc. and impacts of U.S. (military)
- Identify events and information regarding U.S. policies, treaties, interests, etc.
- Identify data sources and select source data.
- Compile and assess selected information and display results.

3d. Establish the nature of hostilities and crises and assess their impact
- Gather hostilities and crisis information based on military movements, geopolitical movements, current intelligence data, and environmental conditions (weather, etc.).
- Determine and identify data sources and select source data. Obtain and display information and assess its impact on U.S. military operations.

3e. Determine U.S., Allied, friendly capability to contain the situation
- Select information sources and compile data concerning U.S. and Allied forces' operational readiness and availability, along with hostilities and crises information.
- Evaluate the selected information and display results.

3f. Determine implications of U.S. involvement
- Select desired information gathered from other activities and tasks stated previously and perform an evaluation.

3g. Evaluate changes in the status of the civil sectors
- Select and evaluate information from situation monitoring activities and tasks. Display results.

3h. Develop combined operations/intelligence situation assessment and briefing
- Collect information from data collected and determine the structure and content of a current situation briefing.
- Filter desired information from data collected and determine the structure and content of a current situation briefing.
- Prepare and present the briefing.

3i. Determine net situation assessment
- Select information/data from previous situation assessment activities and tasks.
- Display selected information from Situation Monitoring function's activities and tasks.

3j. Support the determination that an attack is in progress and provide an assessment of the nature of the attack
- Select information from Situation Monitoring function's activities and tasks.
- Set thresholds and display and evaluate conditions when the thresholds have been exceeded. Correlate conclusion with other sources

4. OPERATIONS PLANNING AND SCHEDULING

OPERATIONS PLANNING AND SCHEDULING includes course of action (COA) development, F/R allocation and movement planning, response option and Operations Plan (OPLAN) development, and feasibility testing in response to warning and threat assessments. Operations Planning and Scheduling activities and tasks are:

4a. Formulate operations objectives and schedule resource utilization
- Select and display information from Force and Resource Status Monitoring and Situation Assessment functions activities and tasks.
- Formulate and postulate feasible operations objectives.
- Determine the resources required to support operations.

4b. Generate and refine F/R requirements and options, movement requirements, and resupply and non-unit personnel requirements
- Select desired information from Force and Resource Status Monitoring function's activities and tasks.
- Generate requirements for single or multiple options
- Prepare a requirements file.

4c. Merge, modify, and tailor force lists and force movement requirements to crisis operations
- Select information from Situation Assessment function's activities and tasks.
- Display and evaluate the selected information.
- Adjust requirements file to meet crisis support needs.

4d. Develop and evaluate potential (COAs), including the definition of COAs and options for situations that may require the use of U.S. military forces. COA development is normally very time-sensitive and involves the determination of forces, logistics support, personnel, and transportation requirements to support contingencies for which no plans exist.
- Select data from Situation Assessment function's activities and tasks
- Formulate, prioritize, and display COAs
- Prepare COA file

4e. Match and select COA/OPLAN force and movement requirements with actual forces and resources, and allocate forces and resources to plans. Includes use of U.S. and/or Allied military forces and material, host nation support.
- Select data from previous task and Force and Resource Status Monitoring function's activities and tasks.
- Determine movement requirements
- Prepare resource allocation file.

4f. Determine and allocate F/R to special logistics requirements such as engineering, POL, ammunition, medical, and other critical areas, as applicable
- Select and display data and information from previous tasks.
- Determine special logistics requirements.
- Prepare special logistics file and adjust the resource allocation file.

4g. Perform plan analysis; determine COA/OPLAN force logistics and transportation availability and feasibility. Identify logistics, transportation, and personnel shortfalls; assess adequacy of plans to achieve objectives, considering intelligence inputs
- Select and display data from previous tasks and Situation Monitoring function's activities and tasks.
- Determine resource shortfalls (personnel and material).
- Determine the adequacy and prioritize the execution of the plans.

4h. Assess projected capabilities to satisfy sustainment requirements for long-range COAs and contingency operations
- Select, evaluate and display data from Force and Resource Status Monitoring function's activities and tasks.
- Assess capabilities to sustain COA plans and operations requirements.

4i. Coordinate deployment routing, air refueling, and scheduling; develop and refine movement tables and schedules
- Select, display, and update data from previous task.
- Prepare movement tables and schedules.
- Coordinate deployment routing and air refueling with associated schedules.

4j. Perform sortie timing, routing, and target assessment; perform reconnaissance planning
- Select and display data from previous tasks and Situation Monitoring function's activities and tasks.
- Develop sortie and reconnaissance requirements to include targets, timing, and routing.
- Prepare sortie and reconnaissance files.

4k. Provide for mobilization of reserves and marshaling of logistics resources
- Select and upgrade data from Force and Resource Status Monitoring function's activities and tasks.
- Prepare, coordinate, and issue mobilization plans and schedules
- Issue logistics resources.

4l. Consider generation and coordination of retrograde operations for withdrawal of U.S. and Allied forces and resources from foreign countries. Includes the planning of evacuation activities for U.S. and Allied nationals
- Select and display data from the Situation Monitoring, Force and Resource Status Monitoring, and Situation Assessment functions.
- Determine potential retrograde actions of U.S. and Allied forces.
- Determine potential evacuation requirements of U.S., Allied, and other nationals.
- Prepare retrograde/evacuation action files.

4m. Present plans to decision makers
- Prepare and present a current operations briefing.
- Obtain and record the decisions, guidance and other appropriate information resulting from the briefing.

5. DECISION MAKING AND SUPPORT

DECISION MAKING AND SUPPORT includes briefings and approval/selection of COAs, plans, and response options by commanders. The decision making process is supported by the collection, analysis, integration, correlation, and presentation of information relative to a situation and alternative actions for that situation. Decision Making and Support activities and tasks are:

5a. Coordinate OPORDS, OPLANS, COAs Select and display data from Operations Planning and Scheduling function's activities and tasks.
- Select and display data from Operations Planning and Scheduling function's activities and tasks.
- After selecting OPORDS, OPLANS, and COAs, coordinate with local and outside agencies. Obtain and insert changes and annotations.

5b. Approve and select plans and response options
- Prepare and display plan abstracts and comparison summaries.
- Obtain and enter changes; transmit to users.
- Obtain option selections and approvals.
- Select plan to be implemented in accordance with ROE, commander's guidance, or other predefined criteria.
- Select plan and option from previous task.

5c. Select, approve EAM contents and directives
- Compare, coordinate, and release EAMs and directives.

6. ORDER AND MISSION INSTRUCTION PREPARATION AND DISSEMINATION (AND REPORT-BACK)

ORDER AND MISSION INSTRUCTION PREPARATION AND DISSEMINATION (AND REPORT-BACK) includes the preparation, coordination, dissemination, and receipt verification of warning orders, guidance, EAMs, and force employment directives for planning, executing, and supporting U.S. military actions. Order and Mission Instruction Preparation and Dissemination (And Report-Back) activities and tasks are:

6a. Prepare, coordinate, and disseminate alert, warning, operations, and mission orders, instructions, and supporting plans; transmit directives
- Select data from Decision Making and Support function's activities and tasks.
- Prepare directives by selecting data from previous task and Situation Monitoring and Force and Resource Status Monitoring functions' activities and tasks.
- Prepare, review, and display directives.
- Verify approvals and transmit directives.
- Maintain a communications log.

6b. Ascertain receipt and understanding of orders
- Obtain communications log from previous task.
- Obtain and record receipt of tasking directives from addresses

7. EMPLOYMENT AND EXECUTION OF FORCES (INITIAL AND RECONSTITUTED)

EMPLOYMENT AND EXECUTION OF FORCES (INITIAL AND RECONSTITUTED) includes special operations, conventional force, and Single Integrated Operational Plan (SIOP) and non-SIOP nuclear operations. Reconstitution includes forces and resources held in reserve or reconstituted during/after hostilities. Employment and Execution of Forces (Initial and Reconstituted) activities and tasks are:

7a. Determine intercept profiles and assign targets
- Select data from the following functions: Situation Monitoring, Force and Resource Status Monitoring, and Order and Mission Instruction Preparation and Dissemination.
- Identify threats and prepare threat profiles (area, type, time, nature).
- Assign countermeasures (ground, air, sea, space).
- In coordination with previous function, prepare, release and transmit strike directives.

7b. Provide weapon strike orders
- Identify and classify targets (type, weapon, time).
- Assign strikes (ground, air, sea, space).
- Prepare, coordinate, release, and transmit directives.

7c. Provide for plan execution
- Develop execution elements and times.
- Evaluate execution profiles; develop alternatives and go/no-go criteria

7d. Coordinate execution initiation
- Select execution profile from previous task.
- Coordinate with authorities and obtain command approval.
- In coordination with previous function, transmit execution elements/times. Obtain valid receipts and maintain an acknowledgement log.

7e. Perform force/sortie launch
- In coordination with previous function, prepare and transmit signals
- Record signal transmission times.

7f. Reconstitute and redirect forces
- Select and display data from Force Employment Monitoring function's tasks and activities
- Review intelligence data from Situation Monitoring function's tasks and activities.
- Prioritize shortfalls.
- Determine force and logistics requirements.
- In coordination with previous function, release and transmit reconstitution directives.
- Prepare, coordinate and approve revised operational objectives.
- In coordination with previous function, prepare, approve, release, and transmit revised operations, orders and plans.

7g. Perform retargeting
- Select data from Force Employment Monitoring function's activities and tasks.
- Select targets, assign forces and weapons to selected targets.
- In coordination with previous function, prepare, approve, release, and transmit directives.

8. FORCE EMPLOYMENT MONITORING

FORCE EMPLOYMENT MONITORING includes the collection of information concerning the conduct of U.S. and Allied military missions and operations, determination of progress, measurement of results, identification of shortfalls, and determination of the status and use of F/R. Includes U.S., Allied, and enemy deployment and operations monitoring, strike/damage assessment, reconnaissance, and estimates of residual capabilities. Also addresses force mobilization, sustainment, and retrograde operations monitoring. Force Employment Monitoring activities and tasks are:

8a. Monitor and display U.S. military operations and mission results; receive, correlate, and maintain mission operations information
- Select report data from sources and prepare summaries.
- Transmit summary of detailed report to users.
- Prepare and maintain report/summary file.

8b. Monitor the deployment of forces and material; monitor shipment status
- Select data from Force and Resource Status Monitoring function's activities and tasks.
- Obtain and display forces/material deployment and shipment status data.
- Prepare summaries and transmit to users. Maintain the summaries/report files.

8c. Provide real-time crisis management information to include force movement and logistics data
- Compile crisis management information from executing forces, readiness and report-back data.
- Evaluate data and prepare highlights file to identify anomalies and remedial actions.

8d. Monitor force generation
- Select force generation data and maintain/upgrade force generation data file.

8e. Monitor the movement of forces from home stations to mobilization stations and the movement of nondeploying material within CONUS
- Compile force movement data on home station to mobilization point and CONUS non-deploying material.
- Prepare and maintain files on both types of data

8f. Monitor the reception and onward movement of deploying forces and resources within theaters of operation
- Select data on reception and onward movement of deploying forces and resources.
- Prepare and maintain deploying force movement and resource files.

8g. Monitor the movement and withdrawal of forces and resources from objective areas in other countries, determine withdrawal progress, and identify problem areas. Also includes monitoring the withdrawal of U.S. and Allied civilian personnel from foreign territories
- Identify the withdrawal progress of forces, resources, and U.S. and Allied civilian personnel from other countries. After determining and identifying sources for data, query, select, and display source data.
- Identify problem areas and prepare and maintain files.

8h. Provide reconnaissance information for damage assessment
- Select data from Order and Mission Instruction Preparation and Dissemination (and Report-Back) function's activities and tasks.
- Review surveillance reconnaissance data from Situation Monitoring function.

8i. Provide bomb damage information and weapon strike data; assess U.S. Allied, and enemy operations and strike results
- Select data from previous tasks.
- Display data and assess bomb and other strike damage to U.S. and Allied operations as well as to enemy operations
- Correlate target data.

8j. Provide nuclear detonation information
- Obtain data from Situation Monitoring function's activities and tasks and other Nuclear Detection (NUDET) information. After determining and identifying sources for data, query, select, and display source data

8k. Perform attack, strike, damage and residual capability assessment; estimate remaining operational capability
- Obtain, display, and evaluate selected data from previous tasks and Situation Monitoring function's activities and tasks
- Prepare and maintain residual operational capability file

8l. Compare operations reports with operational objectives and events to determine effectiveness and identify shortfalls
- Obtain data from previous task and Decision-Making and Support function's activities and tasks
- Display and compare data to determine objectives met and upcoming shortfalls
- Annotate OPLANS and prepare shortfalls file

9. HOSTILITIES TERMINATION AND NEGOTIATION

HOSTILITIES TERMINATION AND NEGOTIATION includes U.S., Allied, and enemy capabilities assessments, evaluation of termination conditions/options, and dissemination of operations termination orders. Hostilities Termination and Negotiation activities and tasks are:

9a. Assess termination options, conditions, and proposals
- Determine and identify data sources. Select and display source data.
- Evaluate, rank, and establish a file for options, conditions, and proposals.

9b. Determine implications of termination
- Select data from previous task.
- Evaluate the data and tabulate conclusions.

9c. Assess feasibility of termination; determine degree to which objectives have been achieved
- Select and display specified data from the following functions: Operations Planning and Scheduling (objectives), Force Employment Monitoring (shortfalls), and Employment and Execution of Forces (Initial and Reconstituted) (revised objectives). Display the data.
- Evaluate and assess feasibility of termination.

9d. Define terms of termination
- Select and display specified data from the following functions: Situation Monitoring (U.S. policy data), Force Employment Monitoring, and Employment and Execution of Forces (Initial and Reconstituted) (revised objectives).
- Establish termination terms that support revised objectives most consistent with U.S. policy.

9e. Terminate hostilities and active operations
- Select and display data (termination terms) from previous task and from the following functions: Situation Monitoring (intelligence, etc.) and Force and Resource Status Monitoring (forces, etc.)
- Prepare, coordinate, approve, and release termination plans and directives.
- Transmit plan directives. Obtain valid receipts and maintain a transmit/receive log.

9f. Support negotiations
- Prepare and present briefings, digest, and other information
- Maintain chronological and subject files to support negotiations

9g. Brief NCA, CINCS, commanders on plan execution/termination progress and results
- Select information from the previous task and from other files.
- Prepare and present briefings.

9h. Prepare, coordinate, disseminate operations termination orders
- Select and display information from the approved termination plan.
- Prepare and release operations termination directives.
- Establish termination directives file.
- Obtain authenticated acknowledgement and maintain an acknowledgement log.
- Prepare and deliver announcements and reports as required.

COMMAND CENTER SPACES RELATED TO FUNCTIONS

The generic model of command center mission functions (on pages 1-2 through 1-12) can be used to identify what should be in the many functional spaces within a command center. A thorough and detailed analysis of the specific functions required in a command center is helpful at the outset of an improvement project. Such an analysis will assist all those making the many decisions that must be made throughout the lifetime of the project. In the Worldwide Military Command Control and System (WWMCCS) literature, frequent use is made of the above set of generic command center functions that are universally applicable to WWMCCS, including all unified and specified (U & S) command centers. The functional applications, however, differ from case to case, according to the specific command center involved and in particular, which military service is involved.

The following assignment of particular WWMCCS functions to specific functional core spaces was made based upon "best judgement" discussions with personnel from all military services now operating in existing command center spaces. Table 1-1 lists all the 21 core spaces contained in Part 2. Table 1-2 lists all the 17 support spaces contained in Part 3. For each support space there is a listing of the primary core spaces that are impacted by the successful operations (or not) of that support space. Thus, if a core space is upgraded in an improvement program it is recommended that all relevant support spaces be reviewed for possible upgrade improvements also.

Figure 1-4. Twenty-one Generic Core Spaces

Command Center Core Spaces	Relevant WWMCCS Functions
• **C1 Communications Watch Office** For the communication management personnel who must ensure the command center's electronic connectivity is uninterrupted during both normal and contingency operations. The flow of record communication includes both incoming monitor and assessment information **and** outgoing force employment and mission instruction information.	1a, 1d
• **C2 Weather Office** For the collection of information to monitor, determine, and display the current status and prediction of weather conditions for the command center's area of responsibility (AOR)--primarily to provide weather information in support of force management and contingency operations.	1c
• **C3 Indications/Warning Center** For the collection, monitoring, and analysis of all source intelligence information and the timely provision of said information to the CINC and the Battle Staff in support of the decision making process.	1b, 1f, 3j
• **C4 Damage Assessment Center/RECA** For the centralized coordination of efforts regarding the real-time assessment of damage and evaluation of residual capability during a nuclear conflict.	1g, 2e, 3i, 8h-8l
• **C5 Missile Warning Center** For the collection, monitoring, and analysis of all information related to worldwide missile deployments of all nations. Monitoring includes current status and predictions of target destinations and tracking schedules.	1a, 1f, 1h, 3j
• **C6 CINC Conference Room** For the presentation of the information that enables the CINC and Senior Battle Staff officers to run the command headquarters. For the required periodic updating of the CINC and small subgroups of the Senior Battle Staff during a crisis situation. (This space should also be available for the routing briefings and coordination sessions of the headquarters staff.)	5a-5c, 6a, 9b-9h

Figure 1-4. (Continued)

Command Center Core Spaces	Relevant WWMCCS Functions
• **C7 Current Actions Center/DOT** For the day-to-day collection and assessment of information about AOR events, actions, and situations that contribute to the worldwide monitoring process for strategic and tactical warning indicators. Critical information is evaluated to make accurate and timely decisions concerning the day-to-day management of U.S. military forces.	1c-1g, 7b-7d, 8j, 9a
• **C8 Emergency Actions Room** For the day-to-day collection and assessment of information about AOR events, actions, and situations that contribute to the worldwide monitoring process for strategic and tactical warning indicators. Critical information is evaluated to make accurate and timely decisions concerning the day-to-day management of U.S. military forces.	1a-1h, 7a-7e, 8a-8l, 9a
• **C9 Special Operations Center/OPG** For the centralized focus of an ad hoc group established for the purpose of receiving a specific problem or accomplishing a specific task, typically within a short time frame.	Same as C11 for limited actions
• **C10 Intelligence Center** For the central focus of all source intelligence gathering activities and the compilation and distribution of said intelligence information.	1a-1h, 3b-3d, 3h-3j, 7g, 8i-8j, 9b
• **C11 Battle Staff Support Center/CAT** For the single focus collection and aggregation of the necessary information for planning and scheduling U.S. force operations by the Senior Battle Staff during a crisis situation (or a training exercise). Specific operations include: (1) COA development, (2) F/R allocation and movement scheduling, (3) logistic and movement resource planning, (4) response options, and (5) feasibility testing in response to warning and threat assessments. (This space can also be for the day-to-day functions of many of the Operations Directorate (J-3) personnel. This continuing use of the space will ensure that the systems and building components will be in operational condition when the CAT assembles periodically.)	1a-1b, 2a-2b, 3a-3h, 4a-4d, 4g-4m, 6a-8a-8c, 8l, 9a, 9f-9h,

Command Center Core Spaces	Relevant WWMCCS Functions
• **C12 CAT Briefing Room** For the presentation of the situation assessments and operations plans under development by the Crisis Action Team. Information to be displayed and/or briefed includes COA development, force/resource allocation and movement scheduling, logistic and movement resource planning, response options and plans development.	2a-2e
• **C13 Nuclear Planners Group Center** For the analysis of related information and the development of plans of action for response to nuclear situations. For the direction of nuclear attack warnings, development of civil defense and citizen safety policy, and the support of the Single Integrated Operational Plan (SIOP) mission.	Same as C11 except for Nuclear Operations
• **C14 Command Briefing Area/SBS** For the presentation of the information that describes a crisis situation and the alternative COA for the situation to enable the CINC and the Senior Battle Staff to make their command decisions. The primary location for face to face communication between CINC, Senior Battle Staff, and the Directorates (J-1 thru J-6). For the selection of the specific COA plan to be implemented and the direction of the U.S. forces response. (This space is also the primary place for most all command center briefings -- for training, information, and public relations.)	5a-5c, 6a, 9b-9c, 9e-9h
• **C15 Senior Authority Room** For the workstation of the CINC and/or other designated senior authority near the CAT/BSSC area for immediate use during a crisis situation. The space provides for convenient small group discussions (along with some information display) to assist senior battle staff in their decision making process.	Same as C14 except for smaller "close hold" groups spaces
• **C16 Deployment Actions Center/DAT** For the coordination, management, and consolidation of activities to the deployment of forces and monitoring of deployment actions at the command center.	2a-2e 4a-4m 5a, 5b 8d, 8e 8f, 8g, 8l

Figure 1-4. (Continued)

Command Center Core Spaces	Relevant WWMCCS Functions
• **C17 Reconnaissance Center** For the single source direction and monitoring of all reconnaissance resources and reporting of force status in support of the command center decision making process.	1h, 4j, 4m, 8h-8k
• **C18 Nuclear Warfare Status Center** For the maintenance, collection, analysis, and development of information for presentation and briefing to applicable operations personnel in direct support of the Current Actions Center activities.	1g, 1h, 8a, 8b, 8j, 9a-9c
• **C19 Logistics Coordination Center** For the management of logistic and mobilization actions during crisis operations and the coordination of other agencies which provide transportation and logistic support. For the ability to provide this support in a range of team structures and sizes.	2c, 4a-4h, 4j, 4m, 7f, 7g, 8b, 8c
• **C20 JPS/JOPES Support Area** For the collection, monitoring, and analysis of all operations planning information to the CINC and the Battle Staff in support of the decision making process.	4a-4e
• **C21 Personnel Readiness Center** For the up-to-date monitoring, assessment, and compilation of data regarding the state of readiness of combat forces in support of the command center mission.	2a, 2b, 2e, 3a, 4a-4e, 4g-4m, 5a-5c, 8a-8g

Figure 1-5. Seventeen Generic Support Spaces

Command Center Support Spaces	Relevant CORE Spaces
• **S1 Telecommunications Center** For the monitoring, control, logging of telecommunications, and other related functions in support of the command center decision making process.	All CORE spaces
• **S2 Essential Communications Equipment Room** For the essential electronic equipment that requires absolute TEMPEST and EMP/HEMP protection. The communication equipment contained in this vault must provide the command center connectivity to both receive comprehensive information of critical events and disseminate U.S. forces mission orders.	All CORE spaces requiring tailproof communications
• **S3 Communications Equipment Room/Technical Control Area** For the successful interface of all communications within the command center and for the management and administration effort necessary to support this interface.	C1,S1,S2
• **S4 WIS Center** For the WWMCCS Information System connectivity for message and data handling capabilities. (If EA and CAT spaces are constructed to provide information classification level required for WWMCCS terminals, the WIS facility space may not be required.)	C9,C11
• **S5 Communications-Electronics Equipment Maintenance/ Parts Area** For the repair and maintenance of communications and electronic equipment used within the command center and for the receiving and storage of parts and supplies necessary to maintain smooth, continuous operation of the command center.	All CORE spaces with communication equipment
• **S6 Division AO Offices and Administrative Area** For the direct operation and supervision of the command center, and for the development and execution of approved operations and plans in support of the command center mission and in relation to the command center's area of responsibility.	C7,C8,C9

Figure 1-5. (Continued)

Command Center Support Spaces	Relevant CORE Spaces
• **S7 Division Conference Room** For the presentation and dissemination of critical information that enables key personnel within an operating division to analyze and form decisions. This space should be available for periodic conferences and briefings during both day-to-day operations and crisis operations.	S6
• **S8 Agency Support Area** For the clear coordination of situations requiring support of other government and DoD agencies outside of the specified command center and the accommodation of a designated representative for each of the appropriate agencies.	C11
• **S9 ADP Area/Computer Operations Center** For the maintenance, operation, and technical support of all computer hardware and software in use throughout the center that support the overall mission of the command center.	All spaces with ADP require-ments
• **S10 Projection Room** For the rearscreen video projectors used in presenting information for training or command decisions.	All briefing spaces
• **S11 TV Studio/Visual Recording Facility** To serve as a functional link between graphics production and information display screens by converting graphics or other information to video/audio signals for routing to appropriate conference screens. For recording information in the form of graphics, file, video, or live presentation for later real-time presentation.	All briefing spaces
• **S12 Graphics Production Room** For the development and production of graphic display information used by the briefers in support of the command center analysis and decision making process. The Graphics Production Room supports both conventional and computerized graphics production.	All briefing and display spaces
• **S13 Commander's Area** For the accommodation of the commander and director of the command center and for the presentation of the proper "command image" to those both within and outside of the center.	Directs functions of C7 and establishes C11 when required
• **S14 Security Operations Area** For the protection of the command center operation, the physical security of the command center facility, and the accommodation of administrative aspects of the security operation.	All CORE spaces
• **S15 Training Room** For the enhancement of the abilities and effectiveness of personnel assigned to the command center as well as new command center personnel.	All CORE spaces
• **S16 Personnel Support Room** For the temporary change of environment and/or to provide a relaxing break area away from the core areas for the command center personnel assigned for extended periods of time during contingency exercises and crisis situations.	All CORE spaces
• **S17 Circulation Spaces** For the effective and efficient occupant circulation between all rooms and spaces within the command center and to produce an acceptable level of risk in systems for fire protection and life safety without compromising the command center mission. Fire protection and life safety systems must provide the command center with the capability to reduce the risks of loss of life due to fire, smoke, toxic fumes, panic, hostile threats, and other hazards and emergencies.	All CORE spaces

Because there is a wide variety of current command center facilities with regard to type, size, and configuration, this generic information is presented as a collection of modular functional spaces that can be sized and combined appropriately as required at specific locations. In order to obtain relevant information for the CCDH, CCIP teams visited all fixed command centers of the NMCS and the U&S commands. This research identified new information from persons with several years' actual experience in a variety of existing facilities and circumstances. From this group of approximately 300 C^3I personnel, information was obtained dealing with the mission functions of the specific spaces in their command center. In order to be more definitive about how they accomplish their mission functions, they were asked to develop a list of operations they do, followed by a listing of the specific activities, personnel and equipment necessary. Similar lists from the several persons doing similar things at the various commands were combined into a single, generic listing of the relevant operations, activities, personnel, and equipment required to accomplish a specific portion of the overall command and control mission. These listings were then separated into parts or rooms that appeared to be relevant for the individual spaces within a generic command center.

This part provides generic information for typical core spaces within the command center. Each space is described as a "functional area" where specific mission functions can be effectively accomplished. All relevant information is usually contained on only eight pages. This format is intended so that the project manager of an upgrade can remove the eight pages for a specific space and copy them for distribution to those involved in a particular function (J2 for Intel Watch, J3 for Ops Watch, etc.). This information can be used as a generic reference for:

- Performing evaluations of the existing core spaces within a specific command center
- Developing functional requirements and initial specifications for command center improvement projects
- Developing a concept design for either a new or retrofit command center
- Performing design reviews and evaluations of command center project designs
- Performing evaluations of newly completed or renovated command center core spaces

PART 2 - COMMAND CENTER CORE SPACES

Policy/SOP

The CWO operates continually with rotating shifts of communications specialists. Command center policy dictates that either the CWO space or the equipment within the space be TEMPEST certified to restrict emanations. During an exercise or contingency operation the CWO will provide personnel support to the Essential Communications Equipment area ("Steel Box"). The general consensus is that there is no need for "tempested" rooms when the communications links themselves are not tempested. The controversy revolves around the issue of providing a steel room that can hold off-the-shelf hardware or providing hardware that is standalone EMP/TEMPEST hardened so that it can be moved anywhere. CWO cells may have requirements for Black World protection needs that require SCI compartments to handle actual hardware within the CWO environment. Most communication links are not TEMPEST, though some are.

C1
COMMUNICATIONS WATCH OFFICE

function

For the communication management personnel who must ensure the command center's electronic communication connectivity is uninterrupted during both normal and contingency operations. The flow of record communication includes both incoming monitor and assessment information and outgoing force employment and mission instruction information. *In general, the CWO must be integrated with all* other communications activities to maintain circuits and connectivity and to schedule maintenance. This integration applies nationally - each CWO must be hooked directly to all others or have immediate access links that will facilitate priority communication.

Space Subfunctions:

1a. Receive, maintain, integrate, and display data from external systems, e.g., Intelligence, Department of State.
d. Maintain locations and contacts with key CINC, government, and Allied personnel.

operations

1. Provide monitoring of all communications in and out of a command center.
2. Log and record messages that are assigned to the CWO.
3. Provide for an uninterrupted flow of communications in support of a command center function.
4. Provide secure facsimile operation for a command center.
5. Provide maintenance of a command center communications network to ensure reliable operation.
6. Provide trip support in terms of mobile communications links for specific VIPs that are hooked through the CWO links; and act as POC for preparing future communications needs.

Staff functions and responsibilities for the operation of this space	Primary responsibility for:	Receives input from:	Provides input to:	Performs at:	
Personnel					
Intelligence		●			
Operations	●	●		●	
Logistics		●			
Plans		●		●	
Comm.-Electronics		●	●		

Staff Participation:

Review of the subfunctions and operations associated with this space suggests this mix of functional staff participation. Note that these are generic allocations of staff participation to generically stated subfunctions and operations; they should only be used as initial concept development factors.

activities

1. Monitor communications.
2. Record all messages and maintain log.
3. Maintain communications and facsimile link.
4. Administer communications system.

personnel

- Communications watch officer
- NCOIC
- 2-3 communications technicians
- Clerical support

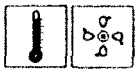
equipment

- 2-3 communications console stations:
  - These stations are part of a communications console that incorporates the required communications links and monitoring equipment.
- Officer and NCO workstation:
  - Worksurface with storage
  - Bookshelves
  - File cabinets and safes
- Clerical support station:
  - Worksurface with storage
  - Typewriter surface
- Ergonomic seating for all stations
- Copier machines
- Supply cabinets
- TV monitors
- SATCOM terminal
- Red and black telephones
- Facsimile terminals
- Autosevocom
- Required database information systems
- LDX printers
- Scanner system
- Pneumatic tube terminal
- Display/white boards

notes

Operational Constraints:

The CWO must operate system-high, at the highest level operating in the command center. Once a CWO space is in place, it is next to impossible to move because of complex communications links and ties to antennas. Power requirements include UPS, TEMPEST, Red/Black separation. The space must be a SCIF, with appropriate physical, procedural, and electronic security measures. Continuous manning is required.

requirements	criteria	commentary
1. Enough space to accommodate the equipment and personnel associated with the Communications Watch Office.	1. Provide space for the monitoring of communications equipment, and for the communications operation personnel required by a command center mission. This space will typically range from 1300 to 1500 sq. ft., and will vary depending upon the array of equipment.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. A secure environment for the monitoring of sensitive/critical information during crisis and non-crisis situations.	2. The Communications Watch Office shall be located within the facility so that discussion and presentation of sensitive material in the space cannot be compromised. The access to the space must be controlled so that no one may enter without proper clearance. All appropriate equipment in the space must be TEMPEST certified.	2.  See TEMPEST section of the Security Systems in CCDH Volume 3 (page 7-33).
3. Interior finishes suitable for durability, maintenance, and room function.	3. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	3.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
4. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	4. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise (NC) should be between NC 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	4.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
5. Comfort features for the occupant such as chair and furniture systems comfort.	5. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	5.  See Seating section in CCDH Volume 3 (page 7-5).
6. Adequate lighting.	6. Lighting shall be specially engineered. Low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	6.  See Interior Lighting in CCDH Volume 3 (page 7-55).
7. Adequate climate control.	7. Control temperature of 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	7.  See HVAC section in CCDH Volume 3 (page 7-65).
8. Accessible power outlets.	8. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall. Provide a raised floor system that allows for easy access to power connections away from the walls.	8. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
9. Fire protection/life safety.	9. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	9.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

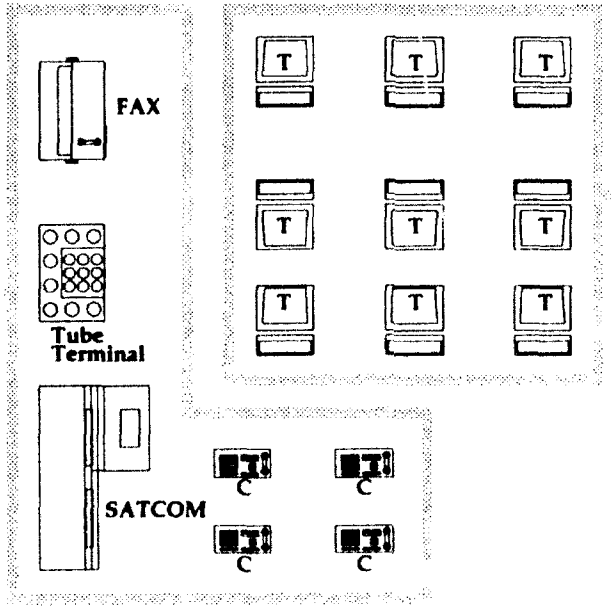
guidance/mission support systems for communication and information processing

• Optimum interoperability of the LAN:
1. In order to take advantage of the IPS currently available, the commands' LAN system will require a UNIX-based platform, and should be compliant with GOSIP, X Window, and Motif standards.
2. AO's connected to the command LAN require terminals similar to UNIX-based integrated workstations.
3. In order to support operations, the LAN requires several laser printers with a minimum of 2 MB of random access memory (RAM).

• Provide optimal LAN connectivity between the command watch teams:
1. Structure the LAN topology as "communities -of-interest" group LANs (e.g., CAT space, LCC space, Intel Center space that all have common interface during a crisis event).
2. Limit LAN briefing area applications to those that support command decision-making (e.g., JVIDS, mapping, message handling, database management).

Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.
4. Access to multi-dimensional message service, including electronic mail and file transfers.
5. Access to internal and external facsimile connections that have multi-level-security.

C = communications handset



Information Processing Subsystem Requirements:
1. Access to a multi-dimensional information processing system that includes:
a. automated message handling system (AMHS)
b. multi-media management and storage system
c. text archival/retrieval system
d. mapping system
e. multi-level security (MLS) gateways
f. distributed processing and heterogenous platform connectivity
2. Computer terminals, connected to all relevant command watch teams, e.g., CSS, Intel, Ops, Logistics, etc.

T = computer terminal

• Adequate facsimile capability:
1. Provide both non-secure and secure facsimile machines with at least one spare machine available at each level.
2. Tie in the FAX capability with the LAN system to take advantage of LAN scanner, printers, etc.

• Minimize numbers of handsets required:
1. Use red/black interface phones to eliminate the need for multiple handsets.
2. Provide phone handsets with user-friendly single/multiple channel control buttons and with a "message window" that indicates the classification level of the call connection.

• Adequate numbers and quality of the secure/nonsecure telephone units:
1. Calls to the telephones of key local and distant individuals are established within 10 seconds or less.
2. Voice clarity over all communication paths is equivalent to STU-111 clarity or better.
3. Provide "precedence" capability to assure the most important C3 messages get through first.

• Adequate numbers and quality of computer terminals:
1. Necessary types of information (e.g.,messages, maps, TV news) can be sent and received.
2. Undetected data errors are negligible.
3. A computer file that is needed quickly (e.g., a photo) can be delivered electronically within one minute to destinations inside the command center and within 10 minutes to remote destinations.

guidance/facility component systems

• Workstation component and seating adjustability for effective ergonomic interaction:

1. Seating for virtually all positions, clerical, computer operator, technician, and supervisory, should be of the type that is adjustable to a range of tasks and individual needs. Adjustments should include seat height, backrest height, seat pan tilt, and backrest angle.
2. Machine and computer keyboard surfaces are especially important in terms of adjustability -- height, slope, and angle. Video display terminals must be placed at the proper viewing height and angle, along with being adjustable for individual operator needs. Worksurfaces must be located at the proper height for the specified task and be adjustable to suit individual occupant requirements. Suggested surface heights include:
   a. working/writing surface: 26"-31".
   b. machine interaction surface: 24"-27".
   c. computer keyboard surface: 24"-30".

• Space located so the personnel can securely and efficiently interact with others -- especially during crisis events:

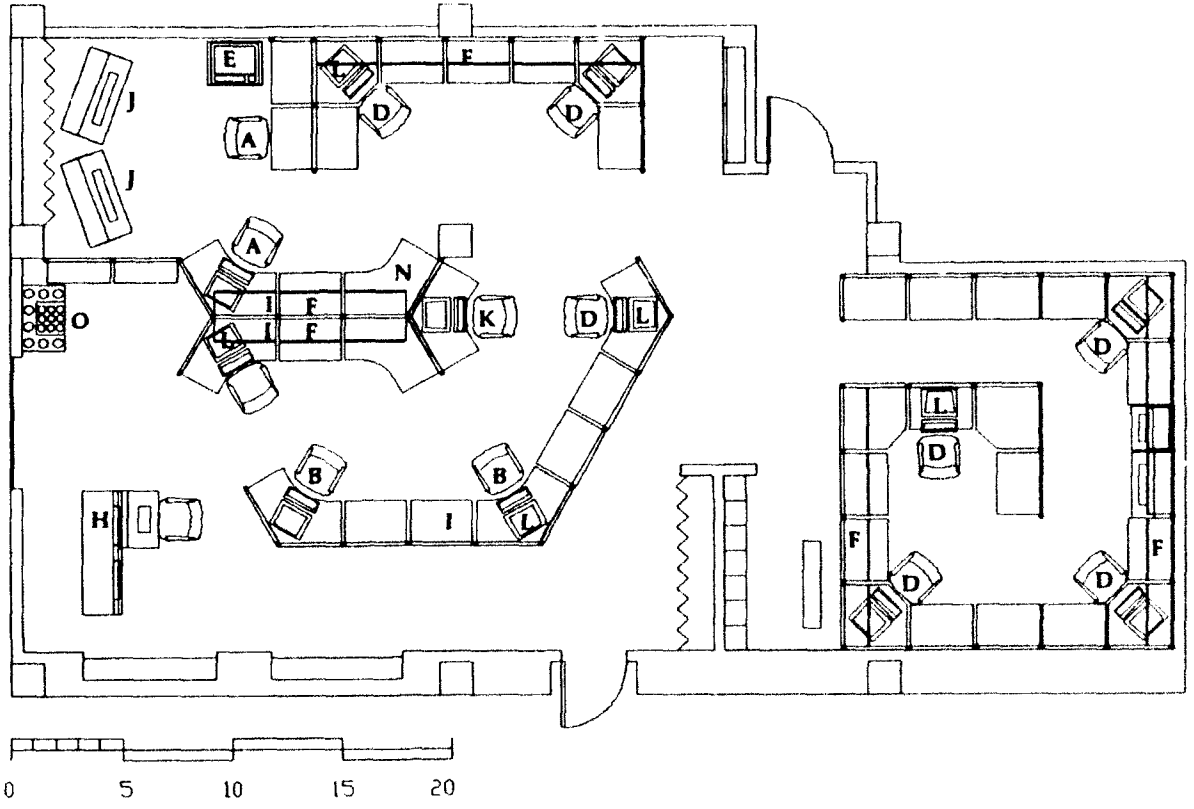
1. This functional space should be located within the core of a command center. The desired location is adjacent to or near the Crisis Action Team space.
2. Typical crisis event activities require that this functional space be located within a SCIF.

• Acceptable travel distance to the nearest building exit during a fire:

1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)

• Acceptable travel distance within the space to the nearest door during a fire:

1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)
2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.



Equipment List

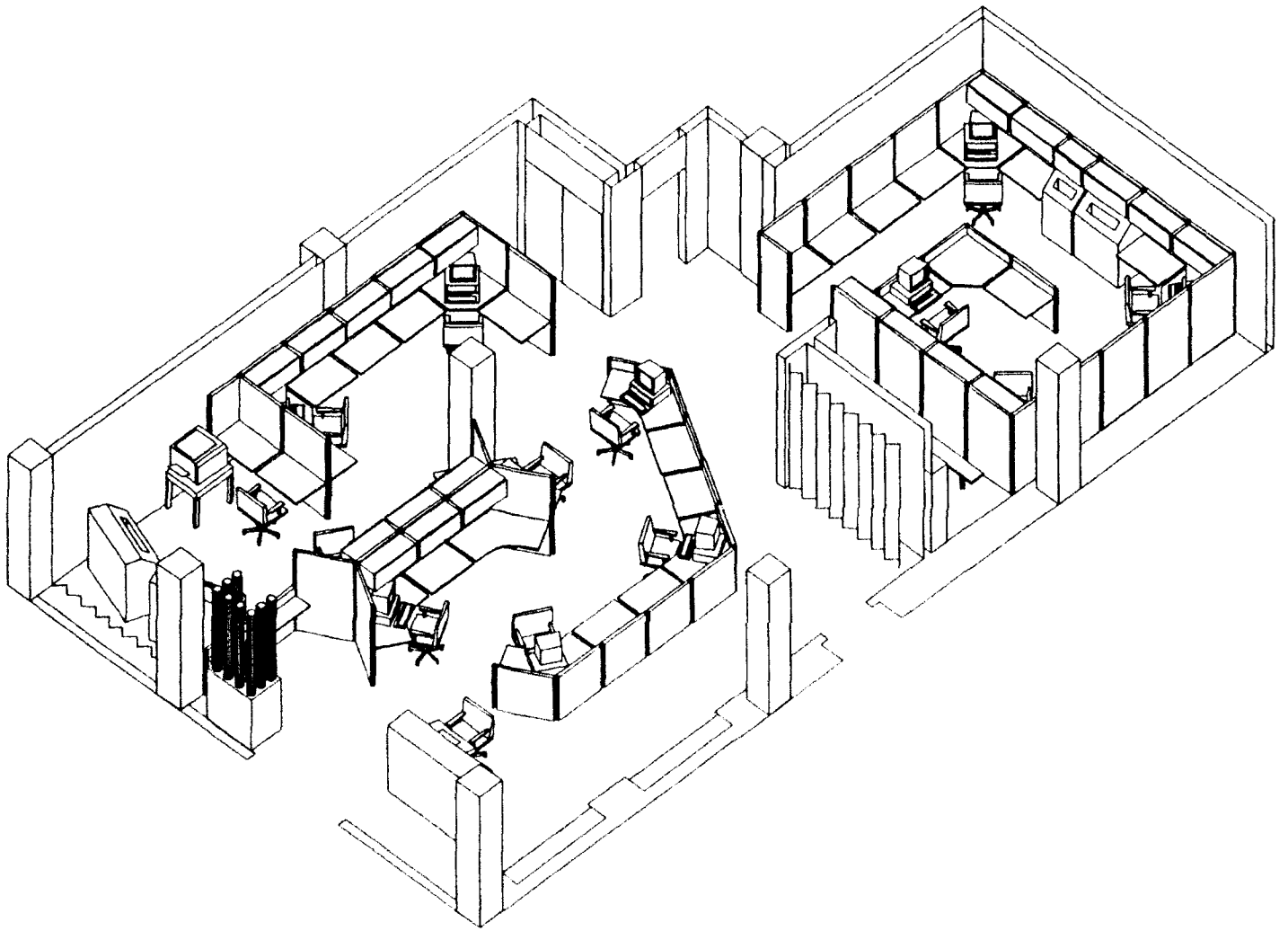
A. 2-3 communications console stations:
- These stations are part of a communications console that incorporates the required communications links and monitoring equipment.

B. Officer and NCO workstation:
- Worksurface with storage
- Bookshelves
- File cabinets and safes

C. Clerical support station:
- Worksurface with storage
- Typewriter surface

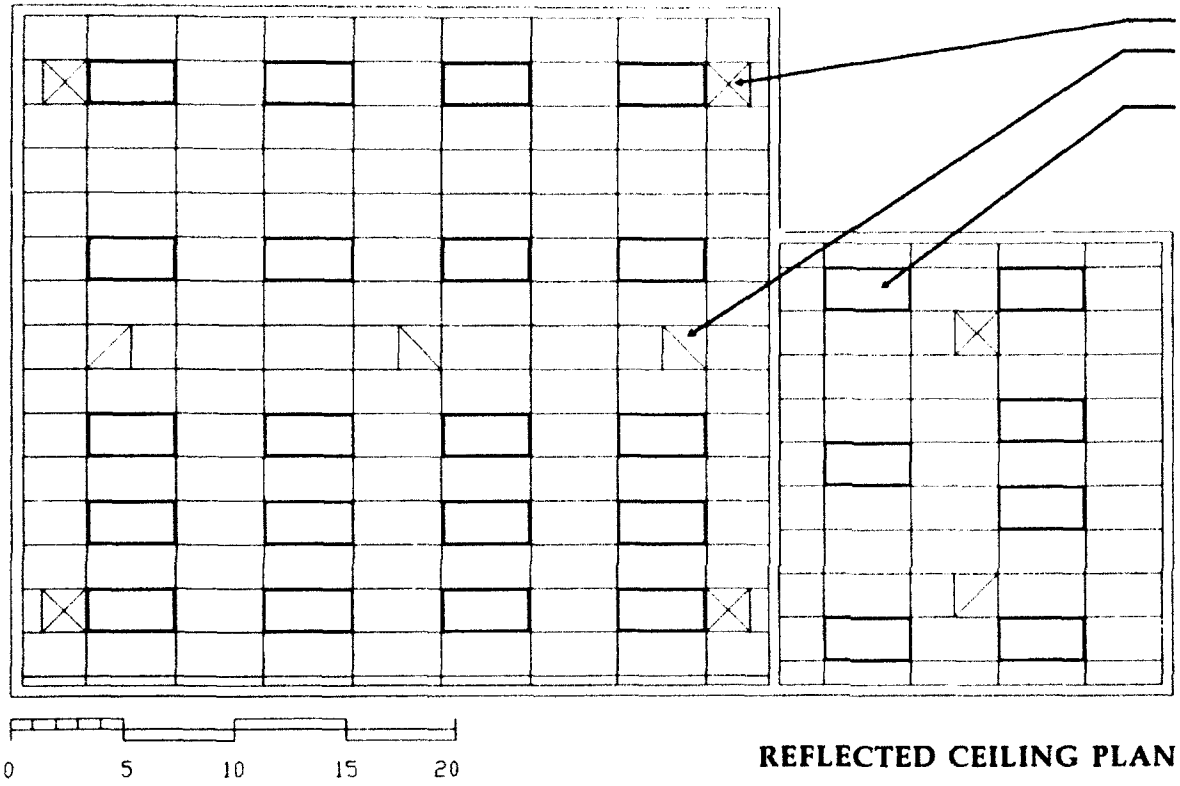
D. Ergonomic seating for all stations
E. Copier machines
F. Supply cabinets
G. TV monitors
H. SATCOM terminal
I. Red and black telephones
J. Facsimile terminals
K. Autosevocom
L. Required database information systems
M. LDX printers
N. Scanner system
O. Pneumatic tube terminal
P. Display/white boards

guidance/facility component systems



• **Impact of HVAC system noises on acoustical conditions:** Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.

guidance/facility component systems



REFLECTED CEILING PLAN

• Optimal building mechanical system for equipment protection:

1. An independent air distribution system for electronic equipment spaces is needed.
2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.
3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall be used in electronic equipment cabinets.
4. Duct fire dampers shall be used in ducts that penetrate two-hour fire resistance-rated walls, partitions, shafts.

• HVAC mechanical system to adequately accommodate electronic-generated heat loads:

1. Heat dissipation by computers, radios, and other electronic equipment is relatively constant; therefore, cooling is required year-round. The room sensible-heat ratio is near unity because heat generated by the computer system is all sensible.
2. The number of required air changes per hour should be 10 to 20 because of the equipment's high heat generation.
3. Humidity control is required year-round to maintain necessary conditions. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components.

• Enable easy ceiling light fixture changes:

1. It is intended that there will be periodic changes in the location of personnel workstations. The ceiling fluorescent light fixtures must be installed in a manner to allow for any fixture unit to be moved to an adjacent ceiling grid module in any direction.

• Minimize reflected glare on VDT screens:

1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

Policy/SOP

Weather Support includes the necessary physical, electrical, communication, and manpower capabilities that provide monitoring, analysis, coordination, and dissemination of the meteorological conditions and forecasts affecting a Command Center's AOR. The Weather Office will be staffed as required by the command center operation and current situation. Some command center weather offices are staffed only on an "as needed" basis during crisis operations, while others are staffed 24 hours a day.

C2
WEATHER OFFICE

function

For the collection of information to monitor, determine, and display the current status and prediction of weather conditions for the command center's area of responsibility (AOR) -- primarily to provide weather information in support of force management and contingency operations.

Space Subfunctions:

1c. Monitor environmental conditions.

operations

1. Provide analysis of weather data/information.
2. Provide the weather portion of the daily briefing for the command center's area of responsibility, and provide routine weather briefings and special ones on an as-needed basis.
3. Provide other weather information, analyses, or forecasts as required by a command center, or as requested by other agencies.
4. Maintain a log and records of weather information and climatological data.
5. Take and disseminate local observations.
6. Provide weather information, forecasts, and analyses in support of flight operations.

Staff functions and responsibilities for the operation of this space	Primary responsibility for:	Receives input from:	Provides input to:	Performs at:	
Personnel					
Intelligence			•		
Operations	•		•		
Logistics					
Plans					
Comm.-Electronics					

Staff Participation:

Review of the subfunctions and operations associated with this space suggests this mix of functional staff participation. Note that these are generic allocations of staff participation to generically stated subfunctions and operations; they should only be used as initial concept development factors.

activities

1. Receive weather information.
2. Prepare forecast and analysis.
3. Access WIN and other database systems.
4. Utilize communication system (voice, data, fax).
5. Receive/display hard copy, charts, maps, etc.
6. Prepare briefings.
7. Metwatch terminals - flight routes.
8. Take and disseminate local observation.
9. Make recommendations to planners based on weather data.

personnel

- 1-5 personnel as determined by command center policy and operation.
- Forecasters (per shift)
- Observers (per shift)
- Briefer (per shift)
- Chief - weekdays

equipment

- Chief's workstation
  - Worksurface
  - Filing/storage
  - Ergonomic chair
  - Side chair
  - Bookcase
- Weather console and ergonomic chairs (1-2 people)
- Shelving for manuals
- File cabinets (including safe)
- Desk with light box and ergonomic chairs for briefers
- Storage cabinet for supplies, maps, charts
- Red/black telephones
- Terminal(s)/printer(s) (separate to improve noise conditions)
- Weather telefax machine
- Facsimile machine
- GOES satellite receiver/dial-up radar
- WIN terminals
- NEDS/NIDS access or AWDS (Automated Weather Distribution System)
- Microcomputer with printer
- Microfiche viewer

notes

requirements	criteria	commentary
1. Enough space to accommodate the equipment and personnel associated with the weather office.	1. Provide space for the weather information receiving and display equipment and for operations personnel and supervisors as required by the command center. Space required typically ranges from 350 sq. ft. in the small 1-person offices to 500 to 600 sq. ft. in the larger 5-6 person offices.	1.  See Furnishings section in CCDH *Volume 3 (page 7-2).*
2. Interior finishes suitable for durability, maintenance, and room function.	2. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	2.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
3. Acoustical treatment to provide *for a non-disruptive environment* and isolate variable noise levels produced by electronic equipment.	3. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise (NC) should be between NC 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	3.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
4. Comfort features for the occupant such as chair and furniture systems comfort.	4. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	4.  See Seating section in CCDH Volume 3 (page 7-5).
5. Adequate lighting.	5. Lighting shall be specially engineered. Low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. *An ambient level of 70 footcandles using fluorescent* fixtures is optimal.	5.  See Interior Lighting in CCDH Volume 3 (page 7-55).
6. Adequate climate control.	6. Control temperature of 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	6.  See HVAC section in CCDH Volume 3 (page 7-65).
7. Accessible power outlets.	7. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall. Provide a raised floor system that allows for easy access to power connections away from the walls.	7. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
8. Fire protection/life safety.	8. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system Automatic detection/alarm system for Halon underfloor system	8.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

guidance/mission support systems for communication and information processing

• ***Minimize numbers of handsets required***:
1. Use red/black interface phones to eliminate the need for multiple handsets.
2. Provide phone handsets with user-friendly single/multiple channel control buttons and with a "message window" that indicates the classification level of the call connection.

• **Adequate communication switching capacity**:
1. The internal and external communication connectivity needs to be optimal during peak crisis periods. Lead team personnel should have state-of-the-art console access.

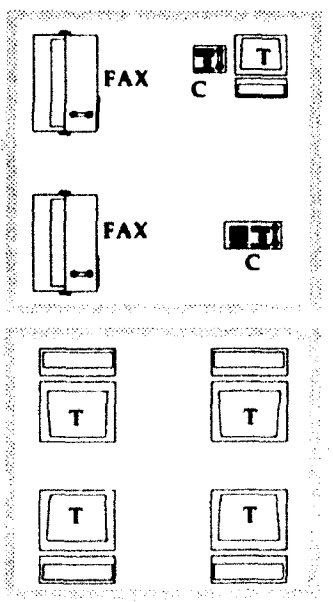
• **Adequate facsimile capability**:
1. Provide both non-secure and secure facsimile machines with at least one spare machine available at each level.
2. Tie in the FAX capability with the LAN system to take advantage of LAN scanner, printers, etc.

• ***Provide optimal LAN connectivity between the command watch teams:***
1. Structure the LAN topology as "communities -of-interest" group LANs (e.g., CAT space, LCC space, Intel Center space that all have common interface during a crisis event).
2. Limit LAN briefing area applications to those that support command decision-making (e.g., JVIDS, mapping, message handling, database management).

• ***Optimum interoperability of the LAN***:
1. In order to take advantage of the IPS currently available, the commands' LAN system will require a UNIX-based platform, and should be compliant with GOSIP, X Window, and Motif standards.
2. AO's connected to the command LAN require terminals similar to UNIX-based integrated workstations.
3. In order to support operations, the LAN requires several laser printers with a minimum of 2 MB of random access memory (RAM).

Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.
4. Access to multi-dimensional message service, including electronic mail and file transfers.
5. Access to internal and external facsimile connections that have multi-level-security.

C = communications handset



Information Processing Subsystem Requirements:
1. Access to a multi-dimensional information processing system that includes:
a. automated message handling system (AMHS)
b. multi-media management and storage system
c. text archival/retrieval system
d. mapping system
e. multi-level security (MLS) gateways
f. distributed processing and heterogenous platform connectivity
g. Automated Weather Distribution System (AWDS)
2. Computer terminals, connected to all relevant command watch teams, e.g., CSS, Intel, Ops, Logistics, etc.

T = computer terminal

• **Adequate numbers and quality of the secure/nonsecure *telephone units:***
1. Calls to the telephones of key local and distant individuals are established within 10 seconds or less.
2. Voice clarity over all communication paths is equivalent to STU-111 clarity or better.
3. Provide "precedence" capability to assure the most important C3 messages get through first.

• **Adequate numbers and quality of computer terminals:**
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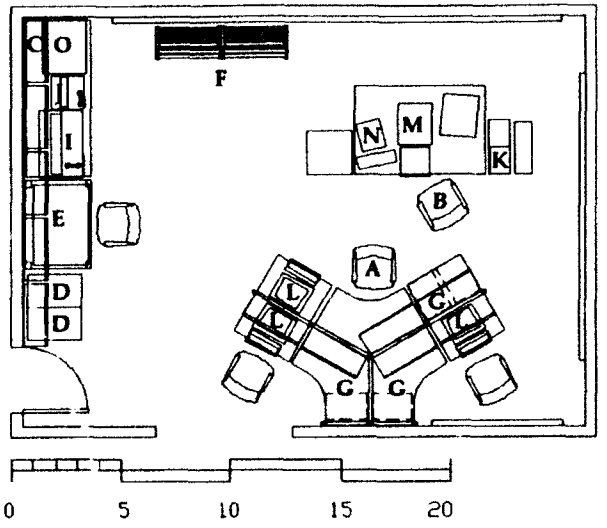
guidance/facility component systems

• **Acceptable travel distance within the space to the nearest door during a fire:**
1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)
2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.

• **Acceptable travel distance to the nearest building exit during a fire:**
1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)

• **Wall treatment for effective graphic displays:**
1. Provide extensive perimeter wall space to allow for the display and review of completed graphic displays. In addition, a 72" x 48" chalkboard/ whiteboard should be periodically provided for the development and display of conceptual ideas. Arranging the personnel workstations in the center of the space makes much of the perimeter wall surface available for the required graphic display and whiteboards.

• **Workstation component and seating adjustability for effective ergonomic interaction:**
1. Seating for virtually all positions, clerical, computer operator, technician, and supervisory, should be of the type that is adjustable to a range of tasks and individual needs. Adjustments should include seat height, backrest height, seat pan tilt, and backrest angle.
2. Machine and computer keyboard surfaces are especially important in terms of adjustability -- height, slope, and angle. Video display terminals must be placed at the proper viewing height and angle, along with being adjustable for individual operator needs. Worksurfaces must be located at the proper height for the specified task and be adjustable to suit individual occupant requirements. Suggested surface heights include:
a. working/writing surface: 26"-31".
b. machine interaction surface: 24"-27".
c. computer keyboard surface: 24"-30".

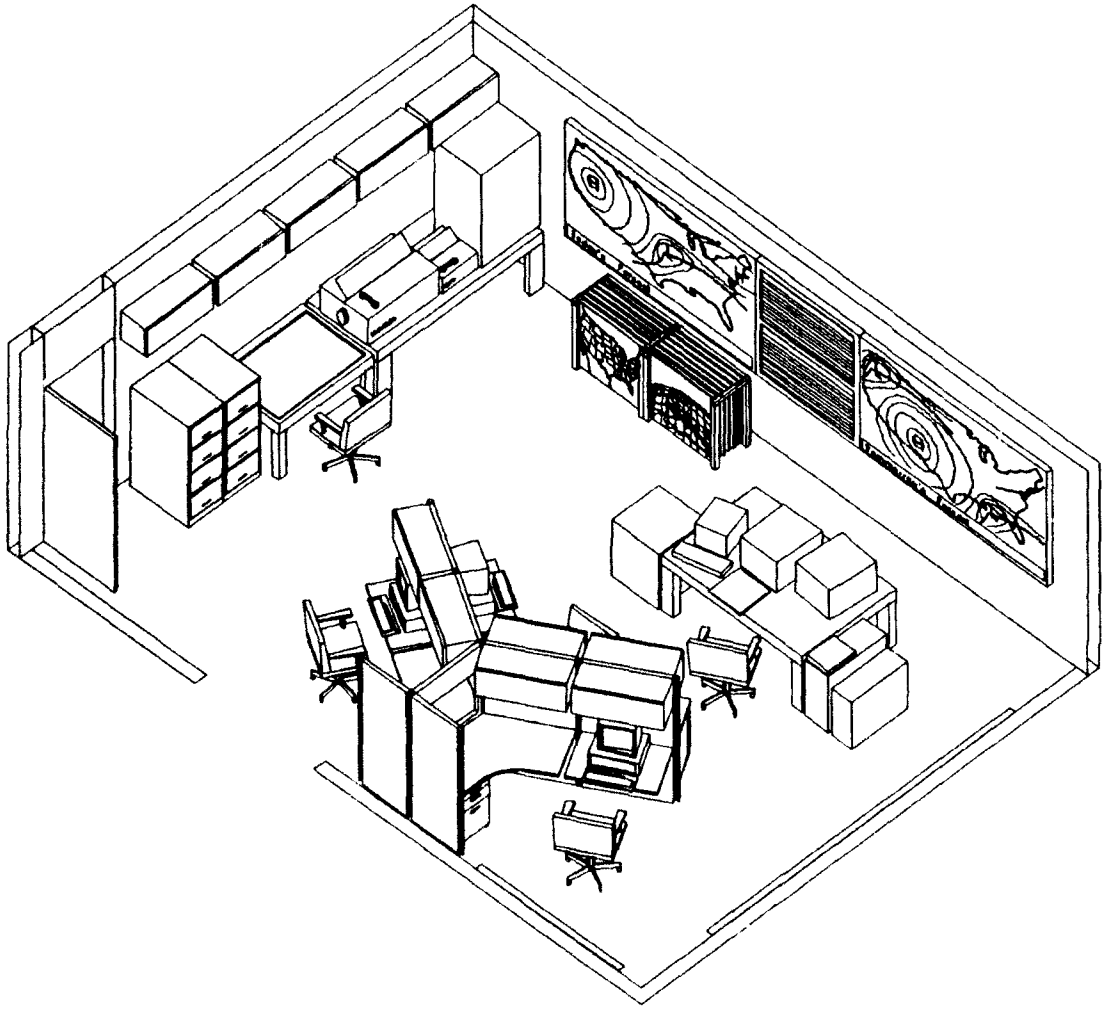


Equipment List

A. Chief's workstation:
- Worksurface
- Filing/storage
- Ergonomic chair
- Side chair
- Bookcase

B. Weather console
C. Shelving for manuals
D. File cabinets (including safe)
E. Desk with light box and ergonomic chairs for briefers
F. Hanging map and chart file
G. Red/black telephones
H. Terminal(s)/printer(s) (separate to improve noise conditions)
I. Weather telefax machine
J. Facsimile machine
K. GOES satellite receiver/dial-up radar
L. WIN terminals
M. NEDS/NIDS access or AWDS (Automated Weather Distribution System)
N. Microcomputer with printer
O. Microfiche viewer

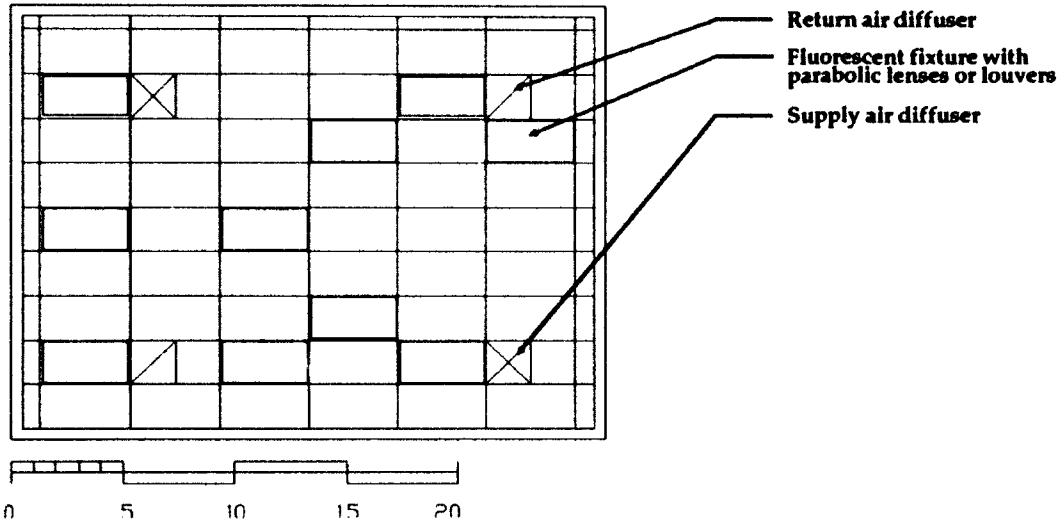
guidance/facility component systems



• **Impact of HVAC system noises on acoustical conditions:** Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.

guidance/facility component systems

REFLECTED CEILING PLAN



• **Minimize reflected glare on VDT screens:**

1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

• **Enable easy ceiling light fixture changes:**

1. It is intended that there will be periodic changes in the location of personnel workstations. The ceiling fluorescent light fixtures must be installed in a manner to allow for any fixture unit to be moved to an adjacent ceiling grid module in any direction.

Policy/SOP

Upon the activation of a Crisis Action Team (CAT), the Indications and Warning Center shall operate on a continuous, 24-hour basis. During 24-hour operations, the I&W Center shall prepare requests for additional personnel and develop a 24-hour schedule for continuous staffing. All equipment shall be periodically tested and maintained to ensure 100% readiness and reliability at any time. Upon activation of the I&W Center the appropriate outside agencies and key personnel within a command center shall be notified by secure means that the I&W Center is in operation. The I&W Center shall be deactivated according to established command center policy upon the termination of a Crisis Action Team. During normal day-to-day operations the I&W function will typically reside in the Intelligence Vault area.

C3
INDICATIONS/WARNING CENTER

function

For the collection, monitoring and analysis of all source intelligence information and the timely provision of said information to the CINC and the Battle Staff in support of the decision-making process.

Space Subfunctions:

1b. Monitor status of global actions, critical events, natural disasters, crisis areas, political/diplomatic/economic developments, non-U.S. military operations, etc.
f. Provide aircraft and missile warning.

3j. Support the determination that an attack is in progress and provide an assessment of the nature of the attack.

operations

1. Provide a center for the collection and analysis of all source intelligence information and integrate all other inteligence centers.
2. Provide support to the CINC and the Senior Battle Staff as required during both normal and crisis situations.
3. Provide intelligence information to the CINC and the Senior Battle Staff.
4. Provide connectivity to both national-level intelligence agencies and the unified and specified commanders.
5. Provide a constant link with the WWMCCS system.
6. Provide a briefing information file on relevant incoming message traffic during CAT activation.
7. Provide intelligence maps, charts and graphics as necessary.

Staff functions and responsibilities for the operation of this space	Primary responsibility for:	Receives input from:	Provides input to:	Performs at:
Personnel				
Intelligence	●			
Operations		●	●	●
Logistics				
Plans				
Comm.-Electronics				

Staff Participation:

Review of the subfunctions and operations associated with this space suggests this mix of functional staff participation. Note that these are generic allocations of staff participation to generically stated subfunctions and operations; they should only be used as initial concept development factors.

activities

1. Operate and maintain all special source information equipment within the Indications/ Warning Center.
2. Generate 24-48 hour intelligence forecast and various threat-driven scenarios.
3. Maintain connectivity with WWMCCS.
4. Prepare intelligence briefing packages for analysis and briefing personnel.
5. Prepare and maintain intelligence situation maps and charts.
6. Maintain security of the I&W facility and the classified material within.

personnel

- 1 senior watch officer (per shift)
- 1-2 watch NCOs (per shift)
- 4-8 intelligence officers

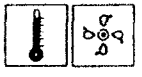
equipment

- Senior watch officer workstation:
  - Worksurface with storage
  - File cabinet
  - Bookcase
  - Ergonomic chair
  - 2 visitor's chairs
- 1-2 NCO workstations:
  - Worksurface with storage
  - File cabinet
  - Ergonomic chair
- 2-4 intelligence officer workstations
  - Worksurface with storage
  - Ergonomic chair
- Full communications support:
  - Commercial
  - Autovon
  - Red switch
  - Intercom
  - PA system
- Classified material container
- Wall maps, charts
- Storage for maps, charts
- Cable TV system
- News service teleprinters
- Link with all applicable information data bases
- World clocks

notes

Operational constraints:

Space security should be as a high-level SCIF with all personnel cleared at highest possible level of operations for that site. Must have special ADP and communications handling procedures. Information processing subsystem has priority. In some, Red/black separation is crucial, and in some commands no unclassified information is allowed in. Storage is crucial and under 2-man control. This is a "no-lone zone" -- no one can be left alone in it. Interaction among personnel is crucial.

requirements	criteria	commentary
1. Enough space to accommodate the equipment, furnishings, and personnel associated with a command center Indications and Warning Center.	1. Provide enough space to house the equipment and personnel workstations within the facility. The amount of space will depend upon the individual command center mission, staffing levels, and the area of responsibility. Typically, the support element will house 8-11 personnel, with fewer personnel being required for the evening and night shifts. For these levels the amount of space necessary would be approximately 1800 sq. ft. for the Indications/Warning Center.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. A secure environment for the monitoring of sensitive/critical information during crisis and non-crisis situations.	2. The Indications/Warning Center areas shall be located within the facility so that discussion and presentation of sensitive material in the space cannot be compromised. The access to the space must be controlled so no one may enter without proper clearance. All appropriate equipment in the space must be TEMPEST certified.	2.  See TEMPEST section of the Security Systems in CCDH Volume 3 (page 7-33).
3. Interior finishes suitable for durability, maintenance, and room function.	3. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	3.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
4. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	4. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise (NC) should be between NC 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	4.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
5. Comfort features for the occupant, such as chair and furniture systems comfort.	5. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	5.  See Seating section in CCDH Volume 3 (page 7-5).
6. Adequate lighting.	6. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	6.  See Interior Lighting in CCDH Volume 3 (page 7-55).
7. Adequate climate control.	7. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	7.  See HVAC section in CCDH Volume 3 (page 7-65).
8. Accessible power outlets.	8. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall. Provide a raised floor system that allows for easy access to power connections away from the walls.	8. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
9. Fire protection/life safety.	9. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	9.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

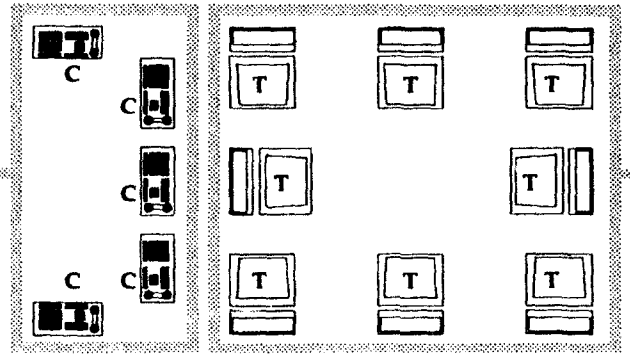
guidance/mission support systems for communication and information processing

• Adequate numbers and quality of the secure/nonsecure telephone units:
1. Calls to the telephones of key local and distant individuals are established within 10 seconds or less.
2. Voice clarity over all communication paths is equivalent to STU-111 clarity or better.
3. Provide "precedence" capability to assure the most important C3 messages get through first.

• Provide optimal LAN connectivity between the command watch teams:
1. Structure the LAN topology as "communities -of-interest" group LANs (e.g., CAT space, LCC space, Intel Center space that all have common interface during a crisis event).
2. Limit LAN briefing area applications to those that support command decision-making (e.g., JVIDS, mapping, message handling, database management).

Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.
4. Access to multi-dimensional message service, including electronic mail and file transfers.
5. Access to internal and external facsimile connections that have multi-level-security.

C = communications handset



• Minimize numbers of handsets required:
1. Use red/black interface phones to eliminate the need for multiple handsets.
2. Provide phone handsets with user-friendly single/multiple channel control buttons and with a "message window" that indicates the classification level of the call connection.

Information Processing Subsystem Requirements:
1. Access to a multi-dimensional information processing system that includes:
a. automated message handling system (AMHS)
b. multi-media management and storage system
c. text archival/retrieval system
d. mapping system
e. multi-level security (MLS) gateways
f. distributed processing and heterogenous platform connectivity
2. Computer terminals, connected to all relevant command watch teams, e.g., CSS, Intel, Ops, Logistics, etc.

T = computer terminal

• Adequate numbers and quality of computer terminals:
1. Necessary types of information (e.g.,messages, maps, TV news) can be sent and received.
2. Undetected data errors are negligible.
3. A computer file that is needed quickly (e.g., a photo) can be delivered electronically within one minute to destinations inside the command center and within 10 minutes to remote destinations.

• Adequate communication switching capacity:
1. The internal and external communication connectivity needs to be optimal during peak crisis periods. Lead team personnel should have state-of-the-art console access.

• Optimum interoperability of the LAN:
1. In order to take advantage of the IPS currently available, the commands' LAN system will require a UNIX-based platform, and should be compliant with GOSIP, X Window, and Motif standards.
2. AO's connected to the command LAN require terminals similar to UNIX-based integrated workstations.
3. In order to support operations, the LAN requires several laser printers with a minimum of 2 MB of random access memory (RAM).

guidance/facility component systems

• **Space located so the personnel can securely and efficiently interact with others -- especially during crisis events:** This functional space should be located within the core of a command center. Desired location should be adjacent to or near the Crisis Action Team space. Typical crisis event activities require that this functional space be located within a SCIF.

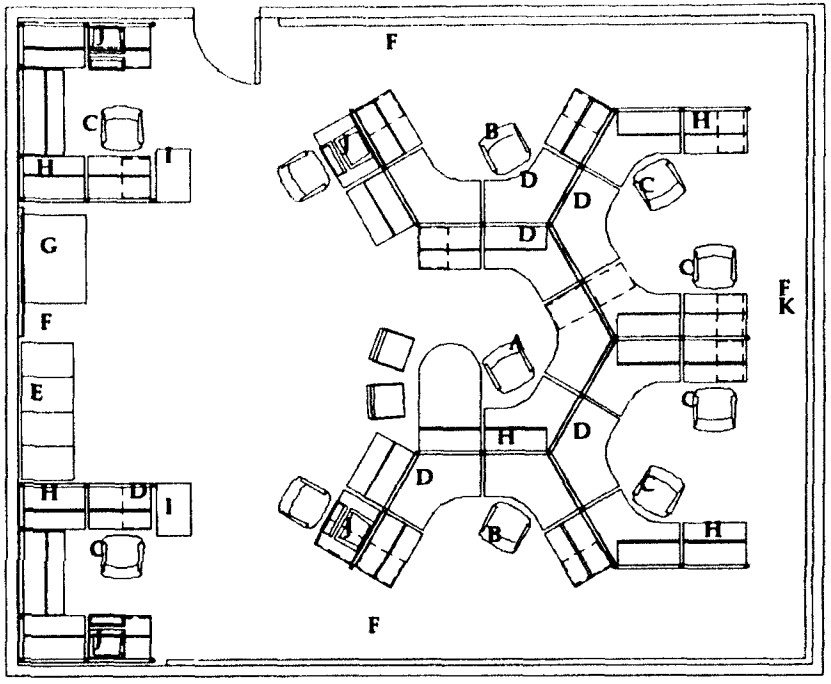
• **Workstation component and seating adjustability for effective ergonomic interaction:**
1. Seating for virtually all positions, clerical, computer operator, technician, and supervisory, should be of the type that is adjustable to a range of tasks and individual needs. Adjustments should include seat height, backrest height, seat pan tilt, and backrest angle.
2. Machine and computer keyboard surfaces are especially important in terms of adjustability -- height, slope, and angle. Video display terminals must be placed at the proper viewing height and angle, along with being adjustable for individual operator needs. Worksurfaces must be located at the proper height for the specified task and be adjustable to suit individual occupant requirements. Suggested surface heights include:
a. working/writing surface: 26"-31".
b. machine interaction surface: 24"-27".
c. computer keyboard surface: 24"-30".

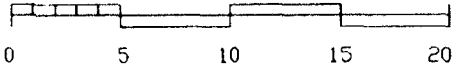
• **Acceptable travel distance within the space to the nearest door during a fire:**
1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)
2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.

• **Optimal individual choice for the extent and location of the componentry in personnel workstation modules:**
1. Provide personnel workstations using system furniture componentry with a single modular dimension of 36". This allows for:
a. easy rearrangement of all components since they will always be compatible with each other.
b. easy removal of individual desk unit components to accommodate floor-mounted equipment, and then the possible replacement of desk units when the equipment is eventually developed as desktop models. Personnel workstations using system furniture 36" components can be configured as either rectangular or hexagonal modules. The hexagonal modules are recommended for this space.

• **Acceptable travel distance to the nearest building exit during a fire:**
1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)

• **Effective relationship of lead personnel to staff:**
1. Locate the senior person(s) at the center of the operational workstations -- with a maximum of 20 to 25 feet from the farthest workstations (and/or display screens).





Equipment List

A. Senior watch officer workstation:
- Worksurface with storage
- File cabinet
- Bookcase
- Ergonomic chair
- 2 visitor's chairs

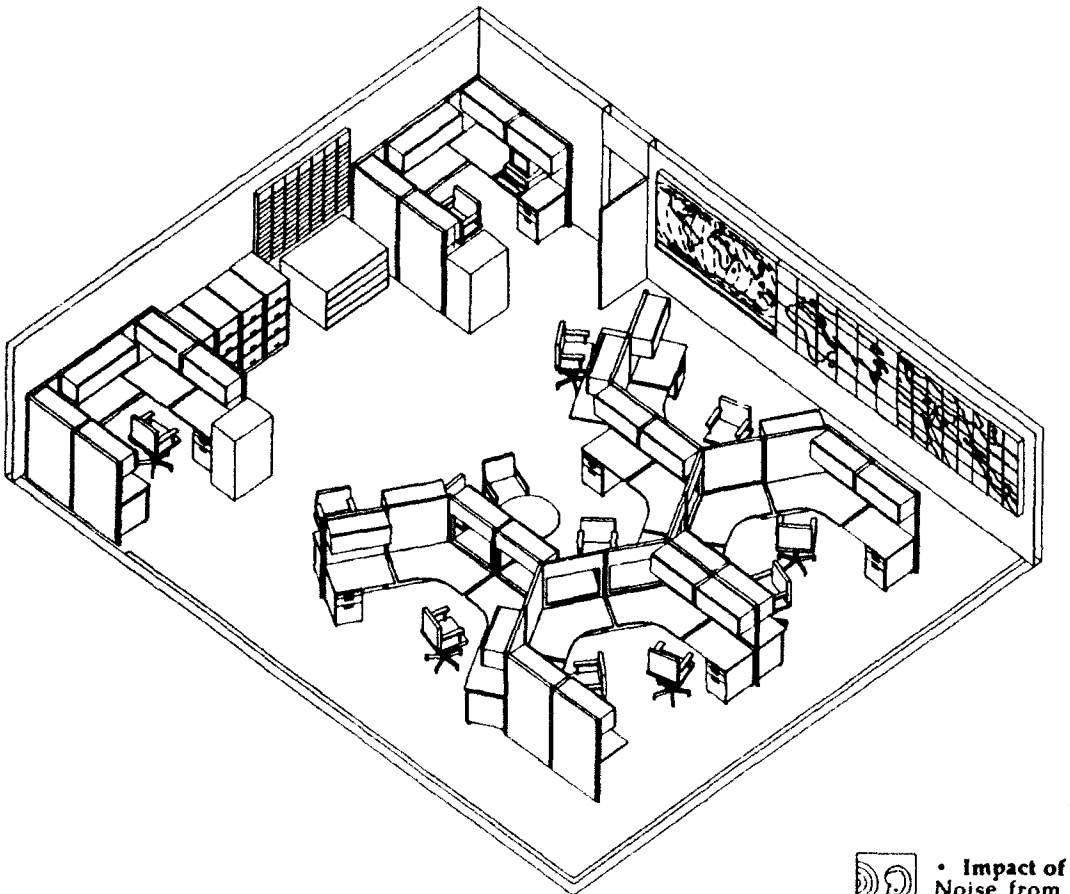
B. 1-2 NCO workstations:
- Worksurface with storage
- File cabinet
- Ergonomic chair

C. 2-4 intelligence officer workstations:
- Worksurface w/storage
- Ergonomic chair

D. Full communications support:
- Commercial
- Autovon
- Red switch
- Intercom
- PA system

E. Classified material container
F. Wall maps, charts
G. Storage for maps, charts
H. Cable TV system
I. News service teleprinters
J. Link with all applicable information data bases
K. World clocks

guidance/facility component systems



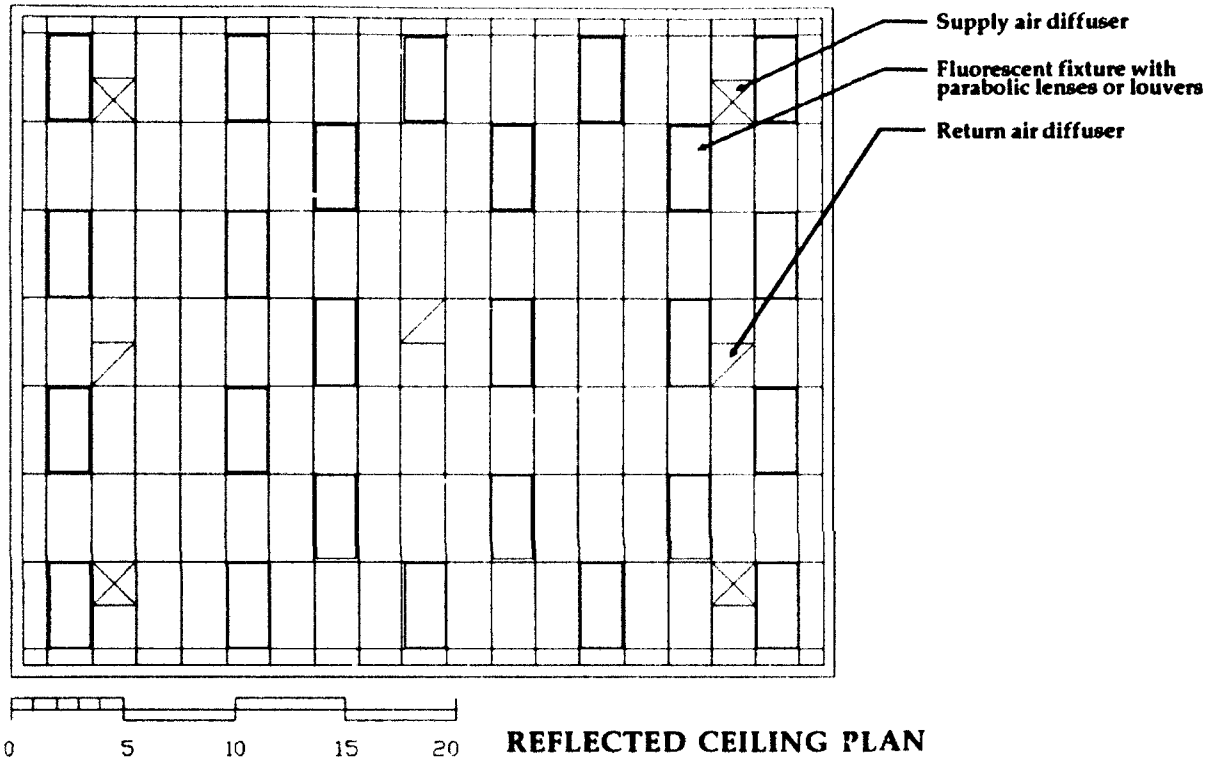
• Effective separation and/or interconnectivity between personnel workstations:
1. Divider partitions between workstations should be 60 inches high (+/-4 inches) to provide visual privacy while occupants are seated and yet not be confining.
2. A number of divider partitions between workstations should be able to be opened or closed as required to allow for either direct personnel interaction when open or for visual privacy when closed. These convertible partitions are especially relevant for hexagonal workstation configurations since each module has party partitions with several adjacent modules.

• Wall treatment for effective graphic displays:
1. Provide extensive perimeter wall space to allow for the display and review of completed graphic displays. In addition, a 72" x 48" chalkboard/whiteboard should be periodically provided for the development and display of conceptual ideas. Arranging the personnel workstations in the center of the space makes much of the perimeter wall surface available for the required graphic display and whiteboards.

• Impact of HVAC system noises on acoustical conditions:
Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.

• Adequate personnel workstation area and appropriate workstation locations:
1. Provide the action officer (AO) workstation furniture as a continuous counter without any kneehole constraints. This allows for:
a. maximum amount of desk-type worksurface area available.
b. maximum choice of where AO and equipment can be located and/or co-located, especially when additional AOs are required to augment the assigned personnel for short time periods.

guidance/facility component systems



REFLECTED CEILING PLAN

• Optimal building mechanical system for equipment protection:
1. An independent air distribution system for electronic equipment spaces is needed.
2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.
3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall be used in electronic equipment cabinets.
4. Duct fire dampers shall be used in ducts that penetrate two-hour fire resistance-rated walls, partitions, shafts.

• Enable easy ceiling light fixture changes:
1. It is intended that there will be periodic changes in the location of personnel workstations. The ceiling fluorescent light fixtures must be installed in a manner to allow for any fixture unit to be moved to an adjacent ceiling grid module in any direction.

• Minimize reflected glare on VDT screens:
1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

Policy/SOP

Individual command center policy will dictate the criteria that will necessitate the activation of the Damage Assessment Center. The Damage Assessment Center will remain in a state of readiness for use at any time a command center policy dictates its activation. Systems and equipment within the Damage Assessment Center will be maintained and tested periodically according to established maintenance policy and manufacturer's recommendations. Because of the nature of activities and type of information in use within the Damage Assessment Center, it must be able to function at the SCI level.

C4
DAMAGE ASSESSMENT CENTER

function

For the centralized coordination of efforts regarding the real-time assessment of damage and evaluation of residual capability during a nuclear conflict.

Space Subfunctions:

1g. Identify nuclear detonations.

2e. Assess force operational readiness capability and availability; identify the deployability status of designated forces.

3i. Determine net situation assessment.

8h. Provide reconnaissance information for damage assessment
- i. Provide bomb damage information, weapon strike data; assess U.S., Allied, and enemy operations and strike results.
- j. Provide nuclear detonation information.
- k. Perform attack, strike, damage, and residual capability assessment; estimate remaining operational capability.
- l. Compare operations reports with operational objectives and events to determine effectiveness and identify shortfalls.

operations

1. Provide facilities and capability to establish and maintain a damage assessment data base.
2. Provide damage estimates in accordance with established formulas and models.
3. Provide damage assessment in support of exercises.
4. Provide residual capability estimates of remaining resources.
5. Provide prioritized listing of reconnaissance requirements.
6. Provide prediction of fallout and radiation contours.
7. Provide training for damage assessment personnel.
8. Provide briefings as required by other command center elements.
9. Provide methods for disseminating information as necessary.

Staff functions and *responsibilities* for the operation of this space	Primary responsibility for:	Receives input from:	Provides input to:	Performs at:
Personnel				
Intelligence		●	●	●
Operations	●			
Logistics		●	●	●
Plans				
Comm.-Electronics			●	

Staff Participation:

Review of the subfunctions and operations associated with this space suggests this mix of functional staff participation. Note that these are generic allocations of staff participation to generically stated subfunctions and operations; they should be used as initial concept development factors.

activities

1. Direct and supervise the Damage Assessment Team.
2. Monitor the current situation within the AOR.
3. Prepare estimates, messages, and reports.
4. Prepare and present briefings.
5. Access appropriate data and information systems.
6. Maintain link with information-reporting sources.
7. Maintain link with other command centers.
8. Receive, display, and prepare hard copy, maps, slides, etc.

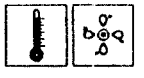
personnel

- 1 Damage Assessment Team Chief
- 1 Damage Assessment Officer (per shift)
- 2-4 Damage Assessment Team personnel (per shift)

equipment

- Damage Assessment Team Chief workstation:
  - Worksurface with storage
  - Bookshelves/file cabinet
  - Conference table
  - 2-4 visitor's chairs
  - Ergonomic chair
- Damage Assessment Officer/NCO:
  - Worksurface with storage
  - Bookshelves/file cabinet
  - Ergonomic chair
- Damage Assessment Team workstation:
  - Custom console with built-in communication, TV monitoring and information retrieval systems
  - Reference shelving, file storage, and ergonomic seating for 2
- Group work area with table and seating for 6
- Wall map, display surface
- Link with all applicable data bases
- Full communications support:
  - Commercial
  - Autovon
  - Red switch
  - Intercom
- NDS G/AIT
- SATCOM/HF radio
- Microcomputer (NPES)
- World clocks

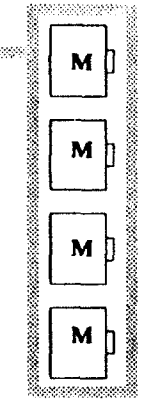
notes

requirements	criteria	commentary
1. Enough space to accommodate the equipment and personnel associated with the Damage Assessment Center and necessary to accomplish the assessment and evaluation function.	1. Space shall be provided to allow for the collection of information to be evaluated in the development of damage estimates and residual capability assessments associated with an exercise or a nuclear conflict. The space may be further divided or subdivided into additional areas as required by the mission and/or the organizational structure of the individual command center. The space may also be partitioned by use of partial height panels to delineate individual workstations. Space has been apportioned into two general areas as follows: Damage Assessment Team Chief 150 to 200 sq. ft. Team Operations Area 600 to 800 sq. ft.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. A secure environment for the monitoring of sensitive/critical information during crisis and non-crisis situations.	2. The Damage Assessment Center shall be located within the facility so that discussion and presentation of sensitive material in the space cannot be compromised. The access to the space must be controlled so no one may enter without proper clearance. All appropriate equipment in the space must be TEMPEST certified.	2.  See TEMPEST section of the Security Systems in CCDH Volume 3 (page 7-33).
3. Interior finishes suitable for durability, maintenance, and room function.	3. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	3.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
4. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	4. Provide for a Sound Transmission Coefficient (STC) of *40 or better in* open office areas with an STC of 45 or better for private offices. Ambient noise should be between(NC) 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	4.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
5. Comfort features for the occupant such as chair and furniture systems comfort.	5. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	5.  See Seating section in CCDH Volume 3 (page 7-5).
6. Adequate lighting.	6. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	6.  See Interior Lighting in CCDH Volume 3 (page 7-55).
7. Adequate climate control.	7. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	7.  See HVAC section in CCDH Volume 3 (page 7-65).
8. Accessible power outlets.	8. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall. Provide a raised floor system that allows for easy access to power connections away from the walls.	8. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
9. Fire protection/life safety.	9. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	9.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

guidance/mission support systems for communication, information processing, and briefing display

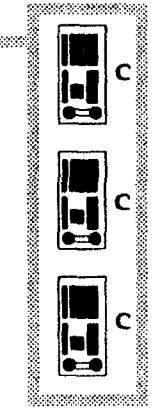
Briefing and Display Subsystem Requirements:
1. Audio amplification system with interconnection to other watch and briefing spaces.
2. Display control console, internal or in an adjacent space for local selection of display images.
3. Video monitors of adequate number and size that will accept all required image signals.

M = LSD monitor



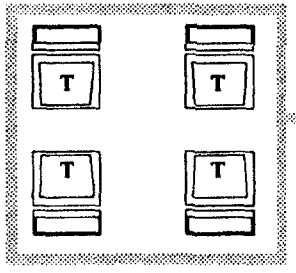
Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.
4. Access to multi-dimensional message service, including electronic mail and file transfers.
5. Access to internal and external facsimile connections that have multi-level-security.

C = communications handset



• **Adequate size and quality of LS monitors based on distance to primary viewers:**
1. Three to five multiple large screen displays with image sizes between 30 inches (diagonal) and 67 inches (diagonal). For high-scan rate displays, consideration may be given to using 48 or 67 inch (diagonal) self-contained projectors.
2. Large-screen monitors are available that provide display sizes from 30 inches (diagonal) to 37 inches (diagonal). Monitor selection is dependent upon video source signals to be displayed. Large video monitors are generally limited to 15 to 36 kilohertz horizontal scan rates. Scan converters may be necessary.
3. Individual monitor speakers or a single switchable speaker may be employed for television audio. A third alternative is to route television signals to one display only with audio following video to a dedicated speaker. Adjustment of speaker volume should be accessible at the podium and the conference table.

• **Convenient local control of LSD images:**
1. Individual keypad or touchscreen local controller to simplify image selection.
2. Local selection of images may be by controller located on podium, however an alternative method of image selection is advisable when briefers do not wish to control images.
3. Requested images should be displayed in acceptable real time of typically 2 to 5 seconds.



Information Processing Subsystem Requirements:
1. Access to a multi-dimensional information processing system that includes:
a. automated message handling system (AMHS)
b. multi-media management and storage system
c. text archival/retrieval system
d. mapping system
e. multi-level security (MLS) gateways
f. distributed processing and heterogenous platform connectivity
2. Computer terminals, connected to all relevant command watch teams, e.g., CSS, Intel, Ops, Logistics, etc.

T = computer terminal

• **Minimize numbers of handsets required:**
1. Use red/black interface phones to eliminate the need for multiple handsets.
2. Provide phone handsets with user-friendly single/multiple channel control buttons and with a "message window" that indicates the classification level of the call connection.

• **Adequate communication switching capacity:**
1. The internal and external communication connectivity needs to be optimal during peak crisis periods. Lead team personnel should have state-of-the-art console access.

• **Adequate facsimile capability:**
1. Provide both non-secure and secure facsimile machines with at least one spare machine available at each level.
2. Tie in the FAX capability with the LAN system to take advantage of LAN scanner, printers, etc.

• **Provide optimal LAN connectivity between the command watch teams:**
1. Structure the LAN topology as "communities -of-interest" group LANs (e.g., CAT space, LCC space, Intel Center space that all have common interface during a crisis event).
2. Limit LAN briefing area applications to those that support command decision-making (e.g., JVIDS, mapping, message handling, database management).

• **Optimum interoperability of the LAN:**
1. In order to take advantage of the IPS currently available, the commands' LAN system will require a UNIX-based platform, and should be compliant with GOSIP, X Window, and Motif standards.
2. AO's connected to the command LAN require terminals similar to UNIX-based integrated workstations.
3. In order to support operations, the LAN requires several laser printers with a minimum of 2 MB of random access memory (RAM).

guidance/facility component systems

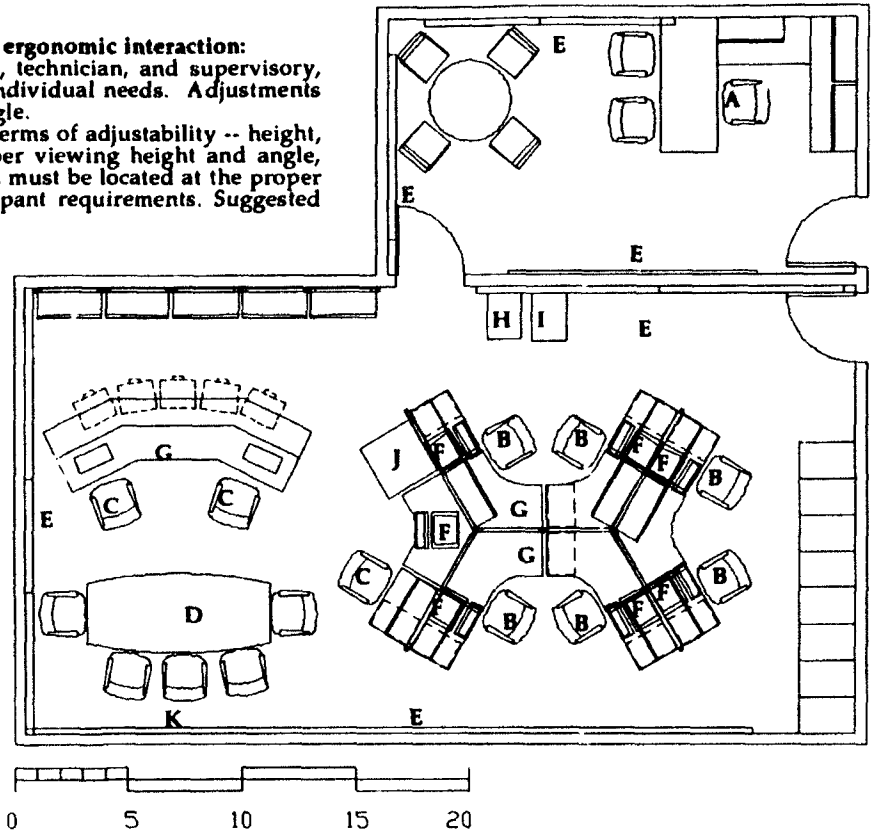
• Workstation component and seating adjustability for effective ergonomic interaction:
1. Seating for virtually all positions, clerical, computer operator, technician, and supervisory, should be of the type that is adjustable to a range of tasks and individual needs. Adjustments should include seat height, backrest height, seat pan tilt, and backrest angle.
2. Machine and computer keyboard surfaces are especially important in terms of adjustability -- height, slope, and angle. Video display terminals must be placed at the proper viewing height and angle, along with being adjustable for individual operator needs. Worksurfaces must be located at the proper height for the specified task and be adjustable to suit individual occupant requirements. Suggested surface heights include:
a. working/writing surface: 26"-31".
b. machine interaction surface: 24"-27".
c. computer keyboard surface: 24"-30".

• Acceptable travel distance within the space to the nearest door during a fire:
1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)
2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.

• Space located so the personnel can securely and efficiently interact with others -- especially during crisis events:
1. This functional space should be located within the core of a command center. The desired location is adjacent to or near the Crisis Action Team space.
2. Typical crisis event activities require that this functional space be located within a SCIF.

• Acceptable travel distance to the nearest building exit during a fire:
1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)

• Effective conferencing activities for group coordination and planning:
1. Provide conference table and chairs adjacent to lead personnel workstation.
2. Provide whiteboard display surface with mounting ledge (approx. 96" x 48").



Equipment List

A. Damage Assessment Team Chief workstation:
- Worksurface with storage
- Bookshelves/file cabinets
- Conference table
- 2-4 visitor's chairs
- Ergonomic chair

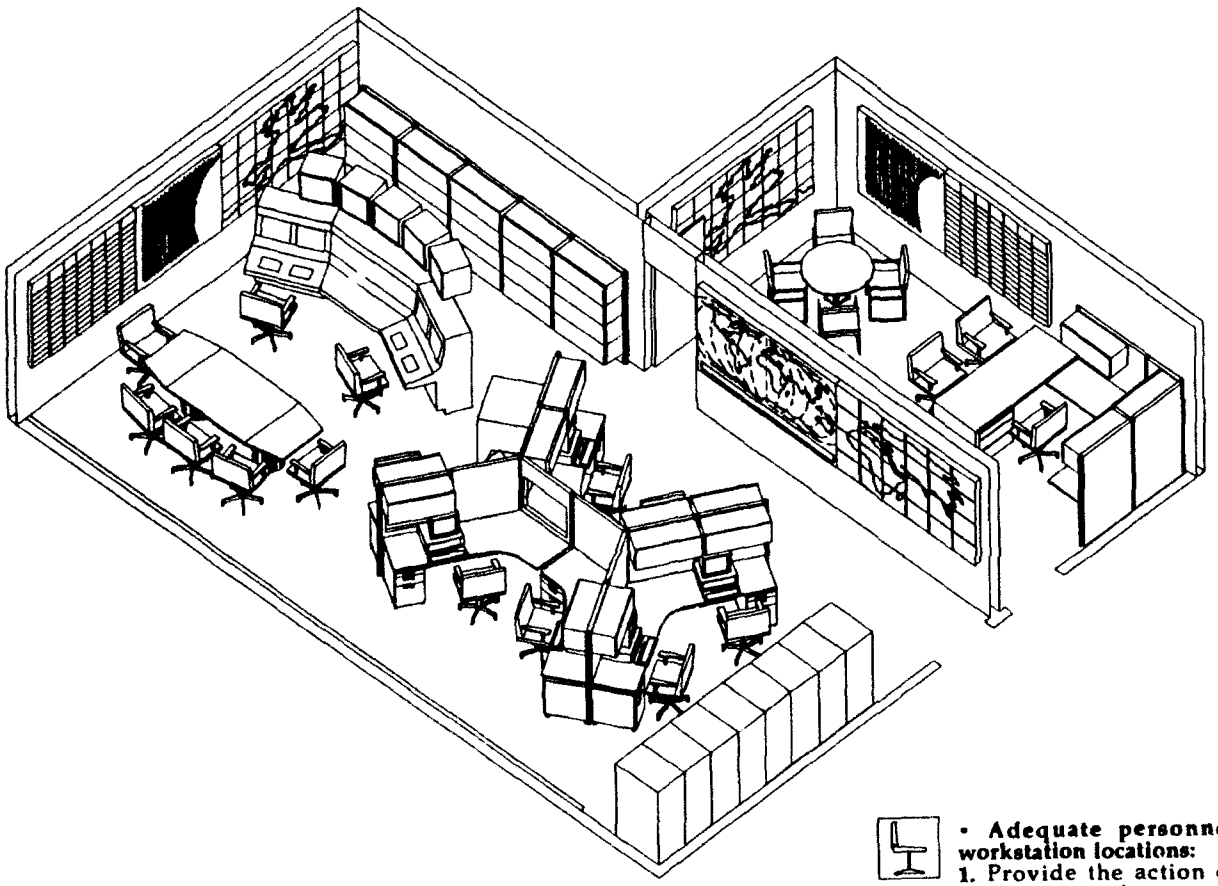
B. Damage Assessment Officer/NCO:
- Worksurface with storage
- Bookshelf/file cabinet
- Ergonomic chair

C. Damage Assessment Team Workstation:
- Custom console with built-in communication, TV monitoring, and information retrieval systems, reference shelving, file storage, and ergonomic seating for 2.

D. Group work area with table and seating for 6
E. Wall map, display surface
F. Link with all applicable data bases
G. Full communications support:
- Commercial
- Autovon
- Red Switch
- Intercom

H. NDS G/AIT
I. SATCOM/HF radio
J. Microcomputer (NFES)
K. World clocks

guidance/facility component systems



• Wall treatment for effective graphic displays:
1. Provide extensive perimeter wall space to allow for the display and review of completed graphic displays. In addition, a 72" x 48" chalkboard/whiteboard should be periodically provided for the development and display of conceptual ideas. Arranging the personnel workstations in the center of the space makes much of the perimeter wall surface available for the required graphic display and whiteboards.

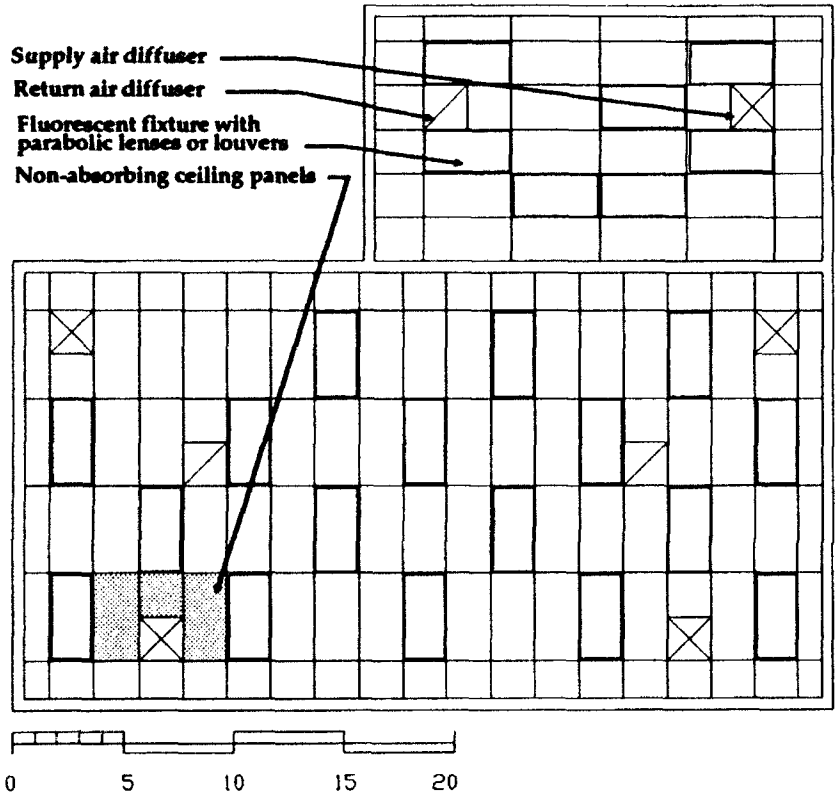
• Impact of HVAC system noises on acoustical conditions:
Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.

• Effective separation and/or interconnectivity between personnel workstations:
1. Divider partitions between workstations should be 60 inches high (+/-4 inches) to provide visual privacy while occupants are seated and yet not be confining.
2. A number of divider partitions between workstations should be able to be opened or closed as required to allow for either direct personnel interaction when open or for visual privacy when closed. These convertible partitions are especially relevant for hexagonal workstation configurations since each module has party partitions with several adjacent modules.

• Adequate personnel workstation area and appropriate workstation locations:
1. Provide the action officer (AO) workstation furniture as a continuous counter without any kneehole constraints. This allows for:
a. maximum amount of desk-type worksurface area available.
b. maximum choice of where AO and equipment can be located and/or co-located, especially when additional AOs are required to augment the assigned personnel for short time periods.
2. Provide the AO system furniture workstations using a standard 36" module throughout. This allows for:
a. easy rearrangement of all components since they will all always be compatible with each other.
b. easy removal of individual desk unit components to accommodate floor-mounted equipment, and then the possible replacement of desk units when the equipment is eventually developed as desktop models.

guidance/facility component systems

REFLECTED CEILING PLAN



• **Optimal building mechanical system for equipment protection:**
1. Independent air distribution system for electronic equipment spaces is needed.
2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.
3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall be used in electronic equipment cabinets.
4. Duct fire dampers shall be used in ducts that penetrate two-hour fire-resistance-rated walls, partitions, shafts.

• **Enable easy ceiling light fixture changes:**
1. It is intended that there will be periodic changes in the location of personnel workstations. The ceiling fluorescent light fixtures must be installed in a manner to allow for any fixture unit to be moved to an adjacent ceiling grid module in any direction.

• **Minimize reflected glare on VDT screens:**
1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

Policy/SOP

This space is only required for those sites with TW/AA missions. This space always functions at the crisis level because of the need to perform constant monitoring of worldwide missile launches. During crisis operations, the Missile Warning Center shall prepare requests for additional personnel as necessary and develop an augmented schedule for continuous staffing. All equipment shall be periodically tested and maintained to ensure 100% readiness and reliability at any time. A testing maintenance schedule shall be developed and approved for this purpose. Except at NORAD, usually one person will occupy this space at a time. He or she must have a view of several monitors at once and must have easy access to numerous keyboards. Facilitating this situation is the primary design requirement for this room. Low-glare lighting and sound attenuation are critical.

C5
MISSILE WARNING CENTER

function

For the collection, monitoring, and analysis of all information related to worldwide missile deployments of all nations. Monitoring includes current status and predictions of target destinations and tracking schedules. Provide instant recognition of any missile launch.

Space Subfunctions:

1a. Receive, maintain, integrate, and display data from external systems.
f. Provide aircraft and missile warning.
h. Direct and task surveillance systems.

2e. Assess force operational readiness capability and availability; identify the deployability status of designated forces.

3j. Support the determination that an attack is in progress and provide an assessment of the nature of the attack.

operation

1. Provide data on any launch, worldwide, indicating the missile type and probable purposes based upon past experience, observed trends, and perceptions.

2. Provide the CINC an analysis of any missile launch in terms of:
   Attack warning
   Attack characterization
   Attack assessment.

3. Provide real-time processing and display of AFSATCOM TW/AA (tactical warning/attack assessment) data.

4. Perform immediate missile launch verification for EA personnel.

5. Provide a daily missile warning system status report to the JCS (as required).

6. Provide operational control of the twelve worldwide missile warning units (as required).

7. Provide maintenance and evaluation to insure the quality and reliability of the Missile Warning System (MWS) computer system.

Staff functions and responsibilities for the operation of this space	Primary responsibility for:	Receives input from:	Provides input to:	Performs at:
Personnel				
Intelligence	●	●	●	●
Operations		●		●
Logistics				
Plans				
Comm.-Electronics			●	

Staff Participation:

Review of the subfunctions and operations associated with this space suggests this mix of functional staff participation. Note that these are generic allocations of staff participation to generically stated subfunctions and operations; they should only be used as initial concept development factors.

activities

1. Monitor current missile launch status.
2. Detect launch.
3. Assess situation.
4. Inform specified personnel of situation.
5. Track missile and maintain continuous status communication.
6. Prepare daily system status reports.
7. Monitor system reliability.

personnel

- Missile warning officer
- Events verification officer
- Missile warning supervisor
- 1-6 missile warning technicians

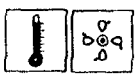
equipment

- Missile warning officer:
  - Workstation with storage
  - Bookshelves/file cabinet
  - Conference table
  - 2-4 visitor's chairs
  - Ergonomic chair
  - PDS
  - MWDS
  - TUDE
  - WDT/TDT
  - CCPDS
  - "hotbox" to the DDO
- Events verification officer/missile warning supervisor:
  - Worksurface with storage
  - Bookshelf/file cabinet
  - Ergonomic chair
- Missile warning technicians:
  - *Custom console with built-in communication, monitoring and information retrieval systems, reference shelving, file storage, and ergonomic seating.*
- Group work area with table and seating for 6
- Wall map, display surface
- Link with all applicable data bases
- Full communications support:
  - Commercial
  - Autovon
  - Red switch
  - Intercom
  - SATCOM/HF radio
- Microcomputer (NDPS)
- World clocks

notes

Operational Constraints:

This space has close ties to the EA (Space C8); the two are usually integrated into the same room. The capability for immediate verbal communication between MW and EA persons is mandatory. The EA and MW personnel frequently crosstrain. Within the MW area, one surveillance officer provides MW and event verification. One technical control technician works in the space, but must leave during any incident. SIOP clearance is necessary for MW personnel.

requirements	criteria	commentary
1. Enough space to accommodate the personnel and equipment associated with the Missile Warning function.	1. Space shall be allocated in order to support all the physical requirements associated with the confirmation of launch and assessment and tracking of missiles. The space may be divided or subdivided further to reflect the needs and organizational structure of the individual command centers. For planning purposes the following spaces and ranges of areas have been determined: Missile Warning Operations 900 to 1000 sq. ft. Missile Warning Equipment 200 to 300 sq. ft.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. A secure environment for the monitoring of sensitive/critical information during crisis and non-crisis situations.	2. The Missile Warning Center areas shall be located within the facility so that discussion and presentation of sensitive material in the space cannot be compromised. The access to the space must be controlled so that no one may enter without proper clearance. All appropriate equipment in the space must be TEMPEST certified.	2.  See TEMPEST section of the Security Systems in CCDH Volume 3 (page 7-33).
3. Interior finishes suitable for durability, maintenance, and room function.	3. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	3.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
4. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	4. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise should be between (NC) 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	4.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
5. Comfort features for the occupant such as chair and furniture systems comfort.	5. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	5.  See Seating section in CCDH Volume 3 (page 7-5).
6. Adequate lighting.	6. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	6.  See Interior Lighting in CCDH Volume 3 (page 7-55).
7. Adequate climate control.	7. Control temp. for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	7.  See HVAC section in CCDH Volume 3 (page 7-65).
8. Accessible power outlets.	8. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall. Provide a raised floor system that allows for easy access to power connections away from the walls.	8. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
9. Fire protection/life safety.	9. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	9.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

guidance/mission support systems for communication and information processing

• **Provide optimal LAN connectivity between the command watch teams:**
1. Structure the LAN topology as "communities -of-interest" group LANs (e.g., CAT space, LCC space, Intel Center space that all have common interface during a crisis event).
2. Limit LAN briefing area applications to those that support command decision-making (e.g., JVIDS, mapping, message handling, database management).

• **Optimum interoperability of the LAN:**
1. In order to take advantage of the IPS currently available, the commands' LAN system will require a UNIX-based platform, and should be compliant with GOSIP, X Window, and Motif standards.
2. AO's connected to the command LAN require terminals similar to UNIX-based integrated workstations.
3. In order to support operations, the LAN requires several laser printers with a minimum of 2 MB of random access memory (RAM).

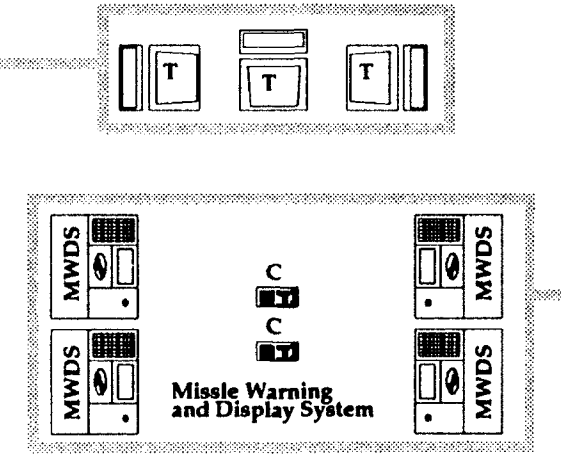
• **Adequate facsimile capability:**
1. Provide both non-secure and secure facsimile machines with at least one spare machine available at each level.
2. Tie in the FAX capability with the LAN system to take advantage of LAN scanner, printers, etc.

• **Minimize numbers of handsets required:**
1. Use red/black interface phones to eliminate the need for multiple handsets.
2. Provide phone handsets with user-friendly single/multiple channel control buttons and with a "message window" that indicates the classification level of the call connection.

• **Adequate communication switching capacity:**
1. The internal and external communication connectivity needs to be optimal during peak crisis periods. Lead team personnel should have state-of-the-art console access.

Information Processing Subsystem Requirements:
1. Access to a multi-dimensional information processing system that includes:
a. automated message handling system (AMHS)
b. multi-media management and storage system
c. text archival/retrieval system
d. mapping system
e. multi-level security (MLS) gateways
f. distributed processing and heterogenous platform connectivity
2. Computer terminals, connected to all relevant command watch teams, e.g., CSS, Intel, Ops, Logistics, etc.

T = computer terminal



Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.
4. Access to multi-dimensional message service, including electronic mail and file transfers.
5. Access to internal and external facsimile connections that have multi-level-security.

C = communications handset

• **Adequate numbers and quality of computer terminals:**
1. Necessary types of information (e.g.,messages, maps, TV news) can be sent and received.
2. Undetected data errors are negligible.
3. A computer file that is needed quickly (e.g., a photo) can be delivered electronically within one minute to destinations inside the command center and within 10 minutes to remote destinations.

• **Adequate numbers and quality of the secure/nonsecure telephone units:**
1. Calls to the telephones of key local and distant individuals are established within 10 seconds or less.
2. Voice clarity over all communication paths is equivalent to STU-111 clarity or better.
3. Provide "precedence" capability to assure the most important C3 messages get through first.

guidance/facility component systems

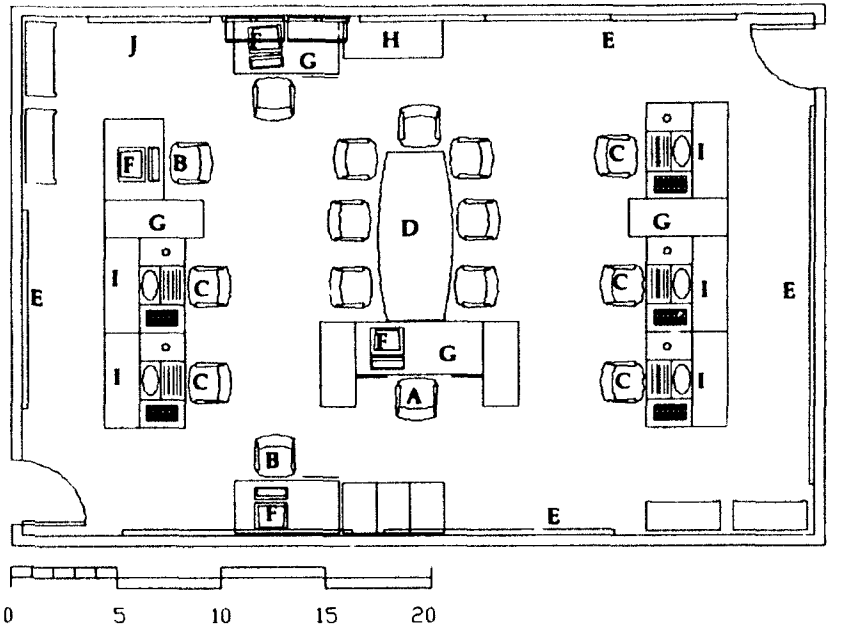
• Space located so the personnel can securely and efficiently interact with others -- especially during crisis events:
1. This functional space should be located within the core of a command center. The desired location is adjacent to or near the Crisis Action Team space.
2. Typical crisis event activities require that this functional space be located within a SCIF.

• Effective relationship of lead personnel to staff:
1. Locate the senior person(s) at the center of the operational workstations -- with a maximum of 20 to 25 feet from the farthest workstations (and/or display screens).

• Acceptable travel distance within the space to the nearest door during a fire:
1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)
2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.

• Acceptable travel distance to the nearest building exit during a fire:
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a. working/writing surface: 26"-31".
b. machine interaction surface: 24"-27".
c. computer keyboard surface: 24"-30".



Equipment List

A. Missile warning officer:
- Worksurface with storage
- Bookshelves/file cabinet
- Conference table
- 2-4 visitor's chairs
- Ergonomic chair

B. Events verification officer/missile warning supervisor:
- Worksurface with storage
- Bookshelf/ file cabinet
- Ergonomic chair

C. Missile warning technicians
- Custom console with built-in communication, monitoring, and information retrieval systems, reference shelving, file storage, and ergonomic seating.

D. Group work area with table and seating for 6

E. Wall map, display surface

F. Link with all applicable data bases

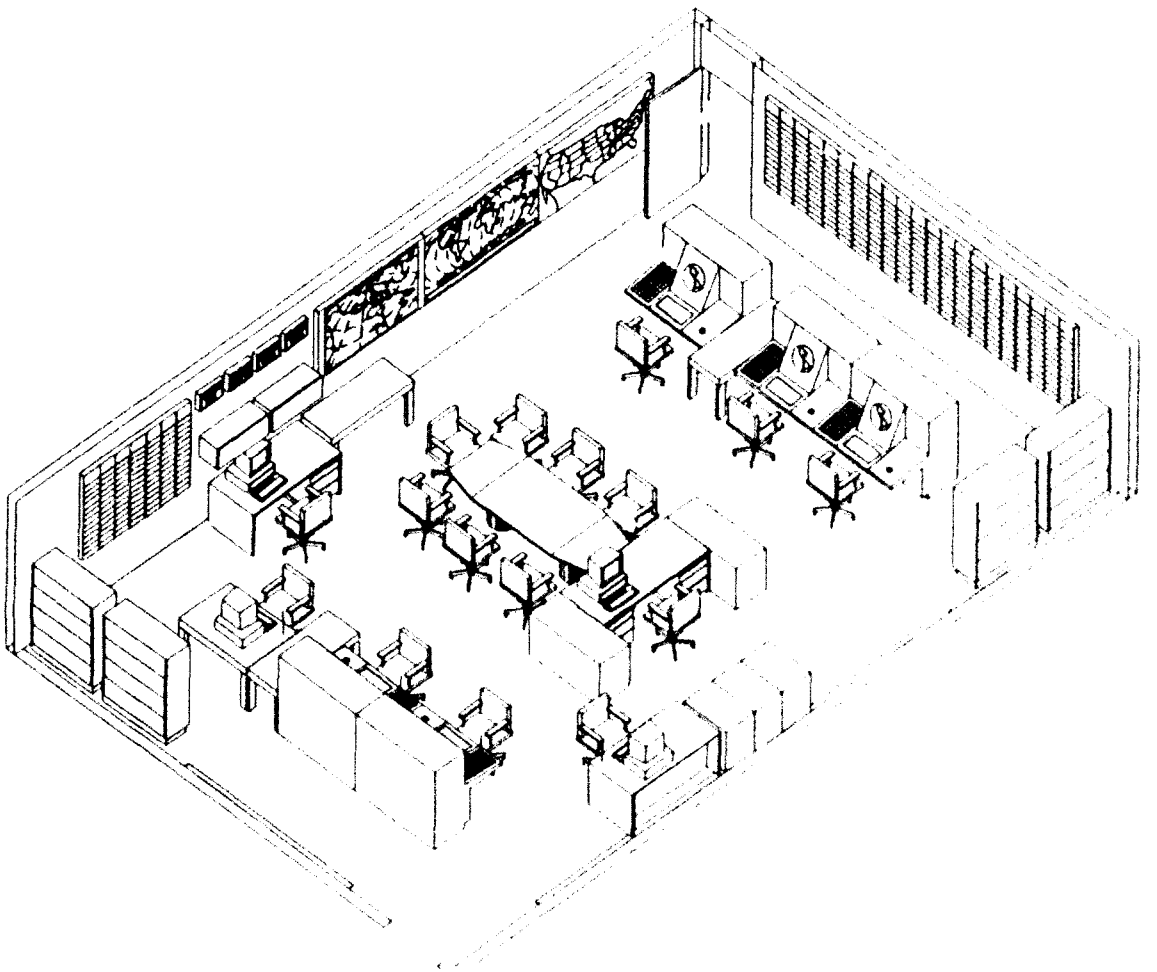
G. Full communications support:
- Commercial
- Autovon
- Red Switch
- Intercom

H. SATCOM/HF radio

I. NORAD processing and display system (NPDS) terminals

J. World clocks

guidance/facility component systems

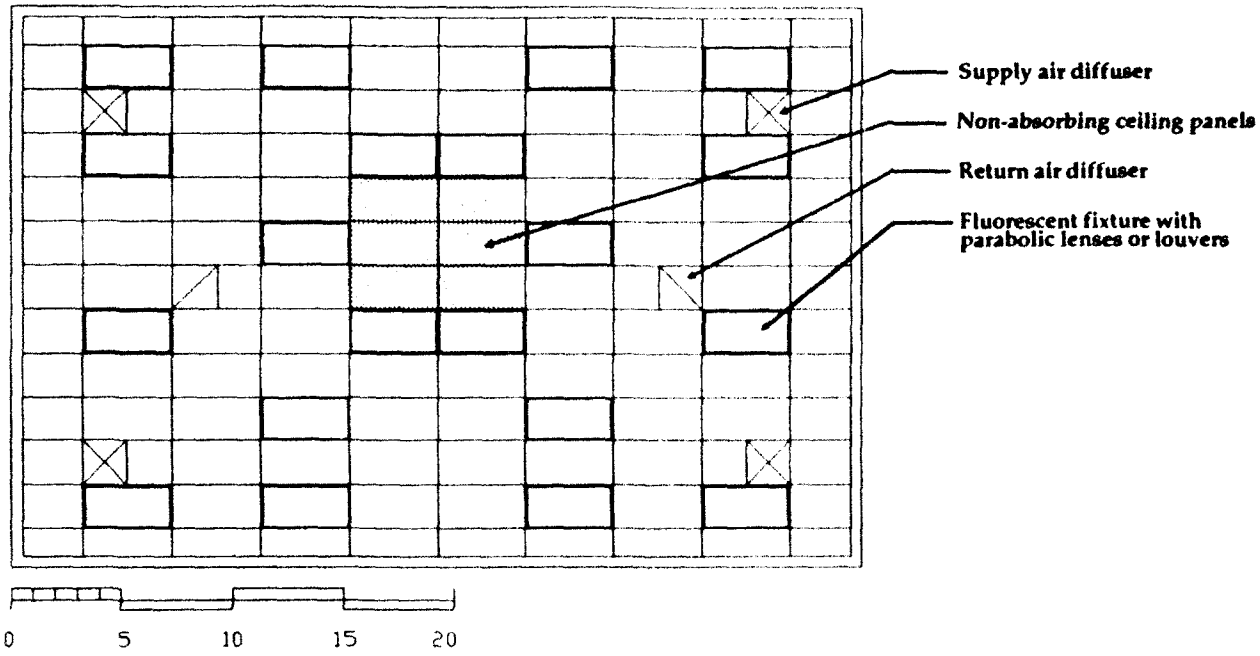


• **Wall treatment for effective graphic displays:**
1. Provide extensive perimeter wall space to allow for the display and review of completed graphic displays. In addition, a 72" x 48" chalkboard/ whiteboard should be periodically provided for the development and display of conceptual ideas. Arranging the personnel workstations in the center of the space makes much of the perimeter wall surface available for the required graphic display and whiteboards.

• **Impact of HVAC system noises on acoustical conditions:**
Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu ft /sec to minimize diffuser turbulence in rooms where optimum hearing is important

guidance/facility component systems

REFLECTED CEILING PLAN



• **Optimal building mechanical system for equipment protection:**
1. Independent air distribution system for electronic equipment spaces is needed.
2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.
3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall be used in electronic equipment cabinets.
4. Duct fire dampers shall be used in ducts that penetrate two-hour fire-resistance-rated walls, partitions, shafts.

• **Enable easy ceiling light fixture changes:**
1. It is intended that there will be periodic changes in the location of personnel workstations. The ceiling fluorescent light fixtures must be installed in a manner to allow for any fixture unit to be moved to an adjacent ceiling grid module in any direction.

• **Minimize reflected glare on VDT screens:**
1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

Policy/SOP

The CINC Conference Room, due to the nature of sensitive material being presented and/or discussed, shall be able to function at the SCI (secure compartmented information) level. The CINC Conference Room shall be maintained in a complete state of readiness for activation at any time or in the event of a crisis situation.

NOTE:
The CINC Conference Room may serve the same function as the Senior Authority Room, providing a remote workspace for the Commander and/or a designated authority at some command centers.

C6
CINC CONFERENCE ROOM

function

For the presentation of the information that enables the CINC and senior staff officers to run the command headquarters. For the required periodic updating of the CINC and small subgroups of the Senior Battle Staff during a crisis situation. (This space should also be available for the routine briefings and coordination sessions of the headquarters staff.)

Space Subfunctions:

5a. Coordinate OPORDS, OPLANS, COAs.
b. Approve and select plans and response options.
c. Select and approve EAM contents and directives.

6a. Prepare, coordinate, and disseminate alert, warning, operations, and mission orders, instructions, and supporting plans; transmit directives.

9b. Determine implications of termination.
c. Assess feasibility of termination; determine degree to which objectives have been achieved.
d. Define terms of termination.
e. Terminate hostilities and active operations.
f. Support negotiations.
g. Brief NCA, CINCs, commanders on plan execution/termination, progress, and results.
h. Prepare, coordinate, disseminate operations termination orders.

operations

1. Provide a secure conference area for the CINC and staff during times of Crisis Action Team activation and during any exercise or contingency operation.
2. Provide for the secure display and presentation and analysis of information, to the top secret level, for the CINC and staff.
3. Provide a secure communications link with other command centers and appropriate agencies.
4. Provide a secure teleconferencing link with other command centers.

Staff functions and responsibilities for the operation of this space	Primary responsibility for:	Receives input from:	Provides input to:	Performs at:
Personnel			●	
Intelligence			●	
Operations	●	●	●	●
Logistics			●	
Plans			●	
Comm.-Electronics			●	

Staff Participation:

Review of the subfunctions and operations associated with this space suggests this mix of functional staff participation. Note that these are generic allocations of staff participation to generically stated subfunctions and operations; they should only be used as initial concept development factors.

activities

1. Monitor situation.
2. Receive information.
3. Display information.
4. Analyze information.
5. Provide decisions.
6. Communicate decisions.

personnel

- CINC
- 7-10 members of CINC staff
- Communications watch officer (for assistance in patching to internal communication systems)
- 1-2 briefers

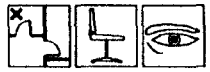
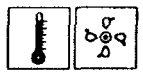
equipment

- Conference management table (This table has space for the CINC and up to 10 staff with built-in video display monitor and communications support equipment.)
- Ergonomic seating for 10
- Lectern with information display control panels
- Full communications support:
  - Autovon
  - Commercial
  - Red switch
  - Intercom
  - Teleconferencing
- Universal workstation for data transfer from all command support cells: Ops, Intel, etc.
- Whiteboard/display surface
- Large-screen display system, rear screen projection screen, as appropriate
- World clocks
- Television/video cameras for teleconferencing

notes

Operational Relationships:

This room must have physical communications links to the EA Room (space C8), CWO (space C1), and Current Action Center (space C7) to facilitate conferencing requirements, data exchange, message preparation, and briefing support.

requirements	criteria	commentary
1. Enough space to accommodate CINC staff briefings and information display equipment.	1. The CINC Conference Room should be large enough to accommodate the CINC and prime staff members, usually about 7 to 10 people. The space necessary for this purpose may range from 300 to 500 sq. ft., depending upon the type and amount of equipment and systems located within the space and whether a projection room is required for rear screen projection.	1  See Furnishings section in CCDH Volume 3 (page 7-2).
2. A secure environment for the monitoring of sensitive/critical information during crisis and non-crisis situations.	2. The CINC Conference Room shall be configured and located within the facility so that discussion and presentation of sensitive material in the space cannot be compromised. The access to the space must be controlled so no one may enter without proper clearance. All appropriate equipment in the space must be TEMPEST certified.	2.  See TEMPEST section of the Security Systems in CCDH Volume 3 (page 7-33).
3. Interior finishes suitable for durability, maintenance, and room function.	3. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	3.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
4. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic euipment.	4. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise should be between (NC) 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	4.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
5. Comfort features for the occupant such as chair and furniture systems comfort.	5. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	5.  See Seating section in CCDH Volume 3 (page 7-5).
6. Adequate lighting.	6. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	6.  See Interior Lighting in CCDH Volume 3 (page 7-55).
7. Adequate climate control.	7. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	7.  See HVAC section in CCDH Volume 3 (page 7-65).
8. Accessible power outlets.	8. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall.	8. See Electrical Power Systems in CCDH Volum : 3 (page 7-70).
9. Fire protection/life safety.	9. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	9.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

guidance/mission support systems for communication, information processing, and briefing display

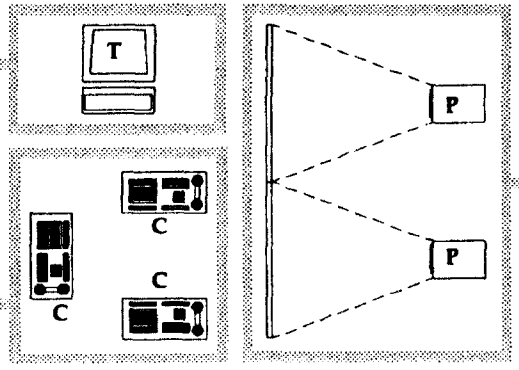
• **Provide optimal LAN connectivity between the command watch teams:**
1. Structure the LAN topology as "communities -of-interest" group LANs (e.g., CAT space, LCC space, Intel Center space that all have common interface during a crisis event).
2. Limit LAN briefing area applications to those that support command decision-making (e.g., JVIDS, mapping, message handling, database management).

Information Processing Subsystem Requirements:
1. Computer terminals, connected to all relevant command watch teams, e.g., CSS, Intel, Ops, Logistics, etc.

T = computer terminal

Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.

C = communications handset



• **Adequate numbers and quality of the secure/nonsecure telephone units:**
1. Calls to the telephones of key local and distant individuals are established within 10 seconds or less.
2. Voice clarity over all communication paths is equivalent to STU-111 clarity or better.
3. Provide "precedence" capability to assure the most important C3 messages get through first.

• **Adequate size and quality of LSD images based on distance to primary viewers:**
1. Up to three large screen displays, with screen sizes 6 to 8 feet wide.
2. CRT LSD projectors offer highest performance/price tradeoff. For 6 to 8 foot wide displays, projectors employing 7 or 8 inch CRTs will provide adequate displays in a medium-to-low light level room. If rear-screen projection is not possible, consider self-contained projection units.)

Briefing and Display Subsystem Requirements:
1. Large-screen projection units, either rear-screen units in an adjacent room or self-contained units within the space.
2. Audio amplification system with interconnection to other watch and briefing spaces.
3. Display control console, internal or in an adjacent space for local selection of display images.
4. Cameras and microphones to support video teleconferencing.

P = rear screen projector

• **Convenient local control of LSD images:**
1. Individual keypad or touchscreen local controller to simplify image selection.
2. Local selection of images may be by controller located on podium, however an alternative method of image selection is advisable when briefers do not wish to control images.
3. Requested images should be displayed in acceptable real time of typically 2 to 5 seconds.

• **Complete video teleconferencing system:**
1. One or two front wall mounted cameras having 500 lines of resolution, with pan, zoom, and tilt capability for at least one camera. An additional camera can be trained on a white instructional board. Overhead graphics camera will support transmission of images from hardcopy.
2. A three-zone microphone system for the conference table, with either push to talk or voice sensing activation.

guidance/facility component systems



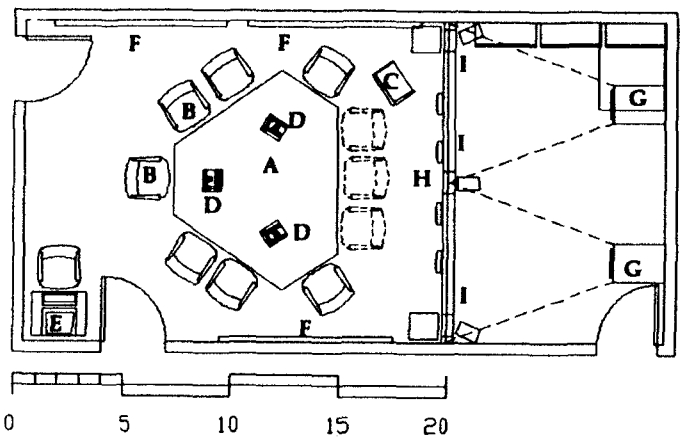
• Effective conferencing activities for group coordination and planning:
1. Provide conference table and chairs adjacent to lead personnel workstation.
2. Provide whiteboard display surface with mounting ledge (approx. 96" x 48").



• Coordination of graphic presentations by briefers:
The briefers' lectern should contain the necessary communication connectivity to control the automated presentations and/or the necessary communication connection to those who do manual presentations. Such controls must be simple and obvious, since the briefers must primarily concentrate on text. (Ambient lighting controls should be on the room walls adjacent to the lec ern rather than being on the lectern itself.)



• Space located so the personnel can securely and efficiently interact with others -- especially during crisis events:
1. This functional space should be located within the core of a command center. The desired location is adjacent to or near the Crisis Action Team space.
2. Typical crisis event activities require that this functional space be located within a SCIF.

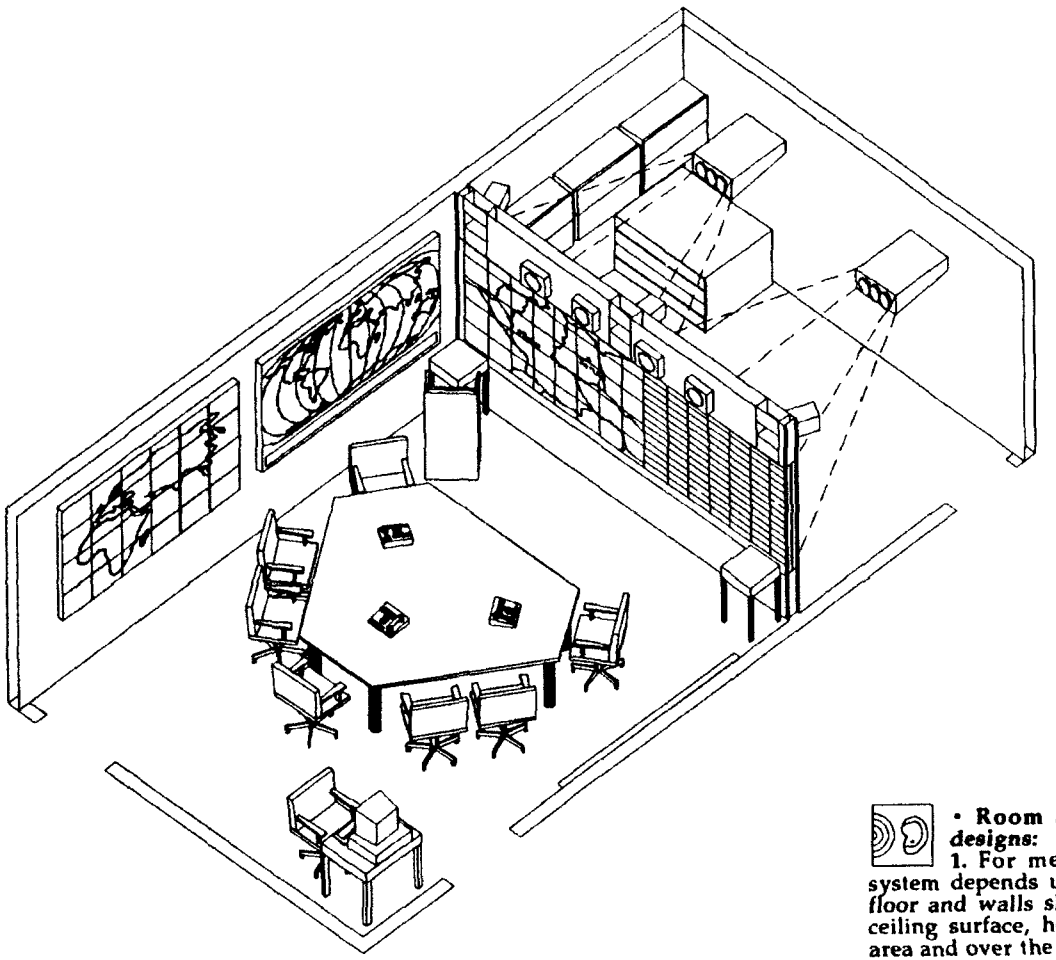


Equipment List

A. Conference management table (This table has space for the CINC and up to 10 staff with built-in video display monitor and communications support equipment.)
B. Ergonomic seating for 10
C. Lectern with information display control panels
D. Full communications support:
- **Autovon**
- **Commercial**
- **Red switch**
- **Intercom**
- **Teleconferencing**

E. Universal workstation for data transfer from all command support cells: Ops, Intel, etc.
F. Whiteboard/display surface
G. Large-screen display system, rear screen projection screen, as appropriate
H. World clocks
I. Television/video cameras

guidance/facility component systems



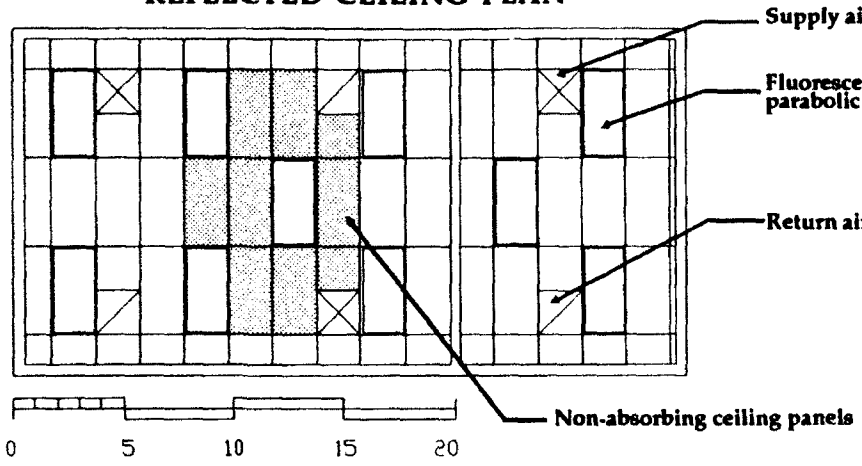
• Adequate brightness of projected graphics:
A rear-screen projector with a minimum output of 1000 lumens is recommended for an approximately eight-foot-wide image. Reducing the screen width to approximately six feet permits the use of projectors with a brightness of 600 lumens. WARNING: Large-screen projector images of highly detailed graphics may have limited legibility no matter how bright they are.

• Room acoustic conditions determined by audio system *designs:*
1. For meeting-type rooms a successful microphone/speaker system depends upon the surface treatment in the room itself. Both the floor and walls should be covered with sound-absorbing materials. The ceiling surface, however, should be reflective over the conference table area and over the observer seating areas.

• Wall treatment for effective graphic displays:
1. Provide extensive perimeter wall space to allow for the display and review of completed graphic displays. In addition, a 72" x 48" chalkboard/ whiteboard should be periodically provided for the development and display of conceptual ideas. Arranging the personnel workstations in the center of the space makes much of the perimeter wall surface available for the required graphic display and whiteboards.

guidance/facility component systems

REFLECTED CEILING PLAN



• **Impact of HVAC system noises on acoustical conditions:**
Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.

• **Optimal building mechanical system for equipment protection:**
1. Independent air distribution system for electronic equipment spaces is needed.
2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.
3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall be used in electronic equipment cabinets.
4. Duct fire dampers shall be used in ducts that penetrate two-hour fire-resistance-rated walls, partitions, shafts.

Policy/SOP

Within each command center, policy has been established to govern center operations. The policy prescribes procedures which dictate:

- Routine day-to-day operations and responsibilities for the Daily Operations Team (DOT).
- Criteria for identifying minor crises and/or the emerging phases of more serious crises.
- The limitations of authority and responsibility in handling crisis situations.
- Notification procedures and command authority.
- Informal means of augmenting the day-to-day operations personnel in response to minor crises.
- Formal means of augmenting the day-to-day operations personnel by the activation of a Crisis Action Team (CAT).

NOTE:
The established policy within each command center may differ based upon the mission and AOR of that particular center. However, the generic framework for policy established herein should be sufficient to gain a working knowledge of the space.

C7
CURRENT ACTIONS CENTER/DOT

function

For the day-to-day collection and assessment of information about AOR events, actions, and situations that contribute to the worldwide monitoring process for strategic and tactical warning indicators. Critical information is evaluated to make accurate and timely decisions concerning the day-to-day management of U.S. military forces.

Space Subfunctions:

1a. Receive, maintain, integrate, and display data from external systems, e.g., State Department, Intelligence.
b. Monitor status of global actions, critical events, natural disasters, crisis areas, political/diplomatic/economic developments, non-U.S. military operation, etc.
c. Monitor environmental conditions.
d. Maintain locations and contacts with key CINC, government, and Allied personnel.
e. Monitor U.S. policies, treaties, agreements, etc.
f. Provide aircraft and missile warning.
g. Identify nuclear detonations.
h. Direct and task surveillance systems.

7a. Determine intercept profiles and assign targets.
b. Provide weapon strike orders.
c. Provide for plan execution.
d. Coordinate execution initiation.
e. Perform force/sortie launch.

8a. Monitor and display U.S. military operations and mission results; receive, correlate, and maintain mission operations information.
b. Monitor the deployment of forces and material; monitor shipment status.
c. Provide real-time crisis management information to include force movement and logistic data.
d. Monitor force generation.
e. Monitor the movement of forces from home stations to mobilization stations and the movement of non-deploying material within CONUS.
f. Monitor the reception and onward movement of deploying forces and resources within theatres of operation.
g. Monitor the movement and withdrawal of forces and resources from objective areas in other countries, determination of withdrawal progress, and identification of problem areas. Also includes monitoring the withdrawal of U.S. and Allied civilian personnel from foreign countries.
h. Provide reconnaissance information for damage assessment.
i. Provide bomb damage information, weapon strike data; assess U.S., Allied, and enemy operations and strike results.

function

j. Provide nuclear detonation information.
k. Perform attack, strike, damage, and residual capability assessment; estimate remaining operational capability.
l. Compare operations reports with operational objectives and events to determine effectiveness and identify shortfalls.

9a. Assess termination options, conditions, and proposals.

operations

1. Day-to-day CAC/DAT operations:
- Monitor politically sensitive operations and military operations within the center's AOR.
- Maintain a complete file of military/political operations within the center's AOR.
- Provide operational reporting and briefings as necessary
- Provide liaison with other government agencies.
- Provide coordination as required with:
  - Operations
  - Weather
  - Intelligence
  - Communications
  - Transportation
  - Automated data processing
  - Logistics.

2. Minor crises or emerging phases of more serious Crises:
- Provide identification of such phase or crisis.
- Provide for implementation of the center's emergency action procedures as required by the situation.
- Provide operational reporting and briefings as necessary.

Note:

The NMCC's operation includes representatives from the National Security Agency (NSA), Central Intelligence Agency (CIA), and Defense Intelligence Agency (DIA), who reside in the Current Action Center and interact with each other, with the current operations section, and with representatives from DISA, who staff the Communication Watch Office (CWO), the Visual Recording Facility, and the Automated Data Processing Liaison Officer (ADPLO). The Naval Watch Office also includes a portion of its Fleet Operations staff in the total personnel requirement.

operations

Staff functions and responsibilities for the operation *of this space*	Primary responsibility for:	Receives input from:	Provides input to:	Performs at:
Personnel		●	●	●
Intelligence		●	●	●
Operations	●	●	●	●
Logistics		●	●	●
Plans		●	●	●
Comm.-Electronics		●	●	●

Staff Participation:

Review of the subfunctions and operations associated with this space suggests this mix of functional staff participation. Note that these are generic allocations of staff participation to generically stated subfunctions and operations; they should only be used as initial concept development factors.

activities

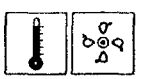
1. Direct/supervise CAC/DAT operation staff.
2. Monitor current situation within the center's AOR.
3. Prepare messages, reports.
4. Prepare briefings.
5. Present briefings.
6. Access WIN and other database systems.
7. Utilize communication system.
8. Receive, display, and prepare hard copy, maps, slides, etc.
9. Maintain contact with other command centers.

personnel

- 1 senior officer (per shift)
- 4-10 operations/administrative personnel (per shift)
- Others as required by the command center operations (see note in operations section)

equipment

- Senior officer workstation
  - Worksurface/console
  - File storage
  - Bookshelves
  - Ergonomic chair
- Operations workstations (4-6):
  - *Custom consoles with built-in communication, monitoring and information retrieval systems*
  - Reference shelving
  - File storage
  - Ergonomic seating
- Emergency action console
- TV system
- WIN terminal(s)
- Red/black phones
- Terminal(s)/printer(s)
- Intercom system
- NIDS/DISIDS
- News service teleprinters
- SATCOM/HF radio
- COPREC
- AMPE
- Microcomputer system (LAN)
- World clocks
- Copy machine(s)
- Wall maps, chart displays

requirements	criteria	commentary
1. Enough space to accommodate equipment and furniture associated with the Current Action Center/Daily Action Team space.	1. Provide space for the monitoring of information systems, terminals, wire services, communications systems, and other equipment, and for operations personnel and supervisors as required by the command center. Space required for the CAC/DAT area typically ranges from 600 sq. ft. in the smaller offices to approximately 1000 to 1400 sq. ft. in the larger offices.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. A secure environment for the monitoring of sensitive/critical information during crisis and non-crisis situations.	2. The CAC/DAT area shall be located within the facility so that discussion and presentation of sensitive material in the space cannot be compromised. The access to the space must be controlled so that no one may enter without proper clearance. All appropriate equipment in the space must be TEMPEST certified.	2.  See TEMPEST section of the Security Systems in CCDH Volume 3 (page 7-33).
3. Interior finishes suitable for durability, maintenance, and room function.	3. ***Floors*** Anti-static carpet in roll goods or tiles over hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	3.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
4. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	4. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise should be between (NC) 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	4.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
5. Comfort features for the occupant such as chair and furniture systems comfort.	5. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	5.  See Seating section in CCDH Volume 3 (page 7-5).
6. Adequate lighting.	6. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	6.  See Interior Lighting in CCDH Volume 3 (page 7-55).
7. Adequate climate control.	7. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	7.  See HVAC section in CCDH Volume 3 (page 7-65).
8. Accessible power outlets.	8. Provide 120/208 electrical service and 120-volt outlets-one receptacle for every 10 linear feet of wall. Provide a raised floor system which allows for easy access to power connections away from the walls.	8. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
9. Fire protection/life safety.	9. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	9.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

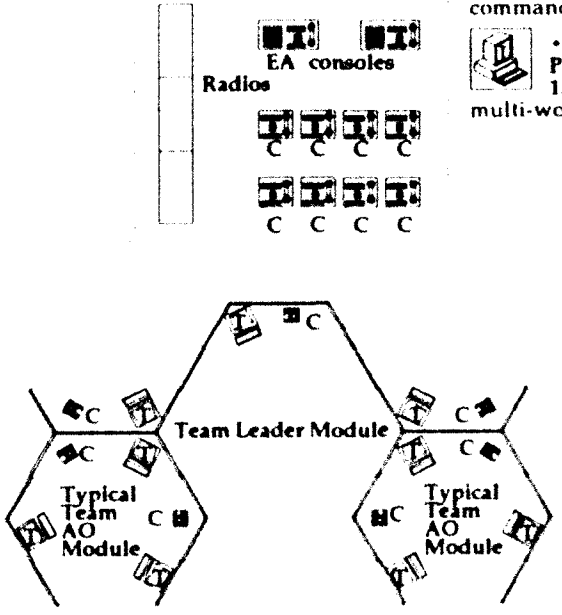
guidance/mission support systems for communication and information processing

• Adequate numbers and quality of the secure/nonsecure telephone units:
1. Calls to the telephones of key local and distant individuals are established within 10 seconds or less.
2. Voice clarity over all communication paths is equivalent to STU-111 clarity or better.
3. Provide "precedence" capability to assure the most important C3 messages get through first.

• Adequate communication switching capacity:
1. The internal and external communication connectivity needs to be optimal during peak crisis periods. Lead team personnel should have state-of-the-art console access.

Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.
4. Access to multi-dimensional message service, including electronic mail and file transfers.
5. Access to internal and external facsimile connections that have multi-level-security.

C = communications handset



• Adequate facsimile capability:
1. Provide both non-secure and secure facsimile machines with at least one spare machine available at each level.
2. Tie in the FAX capability with the LAN system to take advantage of LAN scanner, printers, etc

• Minimize numbers of handsets required:
1. Use red/black interface phones to eliminate the need for multiple handsets.
2. Provide phone handsets with user-friendly single/multiple channel control buttons and with a "message window" that indicates the classification level of the call connection.

• Adequate numbers and quality of computer terminals:
1. Necessary types of information (e.g.,messages, maps, TV news) can be sent and received.
2. Undetected data errors are negligible.
3. A computer file that is needed quickly (e.g., a photo) can be delivered electronically within one minute to destinations inside the command center and within 10 minutes to remote destinations

• Provide optimal LAN connectivity between the command watch teams:
1. Structure the LAN topology as "communities -of-interest" group LANs (e.g., CAT space, LCC space, Intel Center space that all have common interface during a crisis event).
2. Limit LAN briefing area applications to those that support command decision-making (e.g., JVIDS, mapping, message handling, database management).

• Defense Message System (DMS):
1. The DMS will allow for the necessary message service, electronic mail, and file transfer interoperability between EA teams throughout all commands.

• Automated Emergency Action Message Processing and Dissemination System (AEPDS):
1. All EA watch members should have an interactive multi-workstation AEPDS terminal available.

Information Processing Subsystem Requirements:
1. Access to a multi-dimensional information processing system that includes:
a. automated message handling system (AMHS)
b. multi-media management and storage system
c. text archival/retrieval system
d. mapping system
e. multi-level security (MLS) gateways
f. distributed processing and heterogenous platform connectivity
2. Computer terminals, connected to all relevant command watch teams, e.g., CSS, Intel, Ops, Logistics, etc

T = computer terminal

• Optimum interoperability of the LAN
1. In order to take advantage of the IPS currently available, the commands' LAN system will require a UNIX-based platform, and should be compliant with GOSIP, X Window, and Motif standards.
2. AO's connected to the command LAN require terminals similar to UNIX-based integrated workstations
3. In order to support operations, the LAN requires several laser printers with a minimum of 2 MB of random access memory (RAM)

guidance/facility component systems

• Space located so the personnel can securely and efficiently interact with others -- especially during crisis events:

1. This functional space should be located within the core of a command center. The desired location is adjacent to or near the Crisis Action Team space.
2. Typical crisis event activities require that this functional space be located within a SCIF.

• Effective relationship of lead personnel to staff:

1. Locate the senior person(s) at the center of the operational workstations -- with a maximum of 20 to 25 feet from the farthest workstations (and/or display screens).

• Acceptable travel distance within the space to the nearest door during a fire:

1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)
2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.

• Acceptable travel distance to the nearest building exit during a fire:

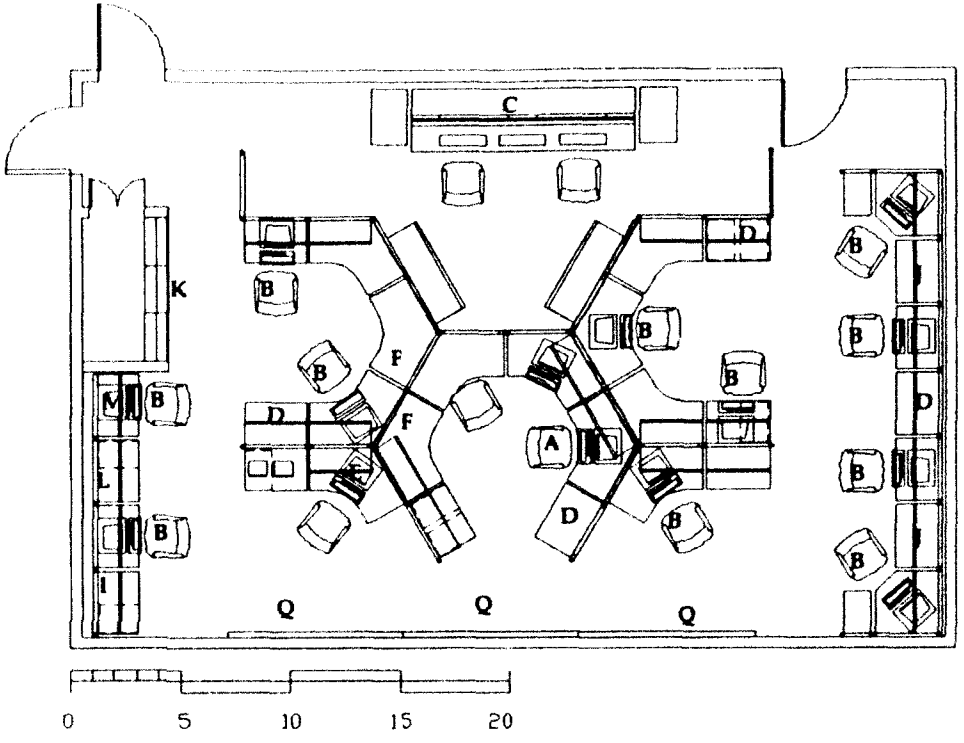
1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)

• Optimal choice for the rearrangement of personnel workstation modules:

1. To maintain a responsive, efficient work environment, space management should be localized with the first supervisors. Local planning and management are needed to retain equitable space allocation, to maintain previously established standards, and to respond efficiently to changing situations.

• Optimal individual choice for the extent and location of the componentry in personnel workstation modules:

1. Provide personnel workstations using system furniture componentry with a single modular dimension of 36". This allows for:
   a. easy rearrangement of all components since they will always be compatible with each other.
   b. easy removal of individual desk unit components to accommodate floor-mounted equipment, and then the possible replacement of desk units when the equipment is eventually developed as desktop models. Personnel workstations using system furniture 36" components can be configured as either rectangular or hexagonal modules. The hexagonal modules are recommended for this space.



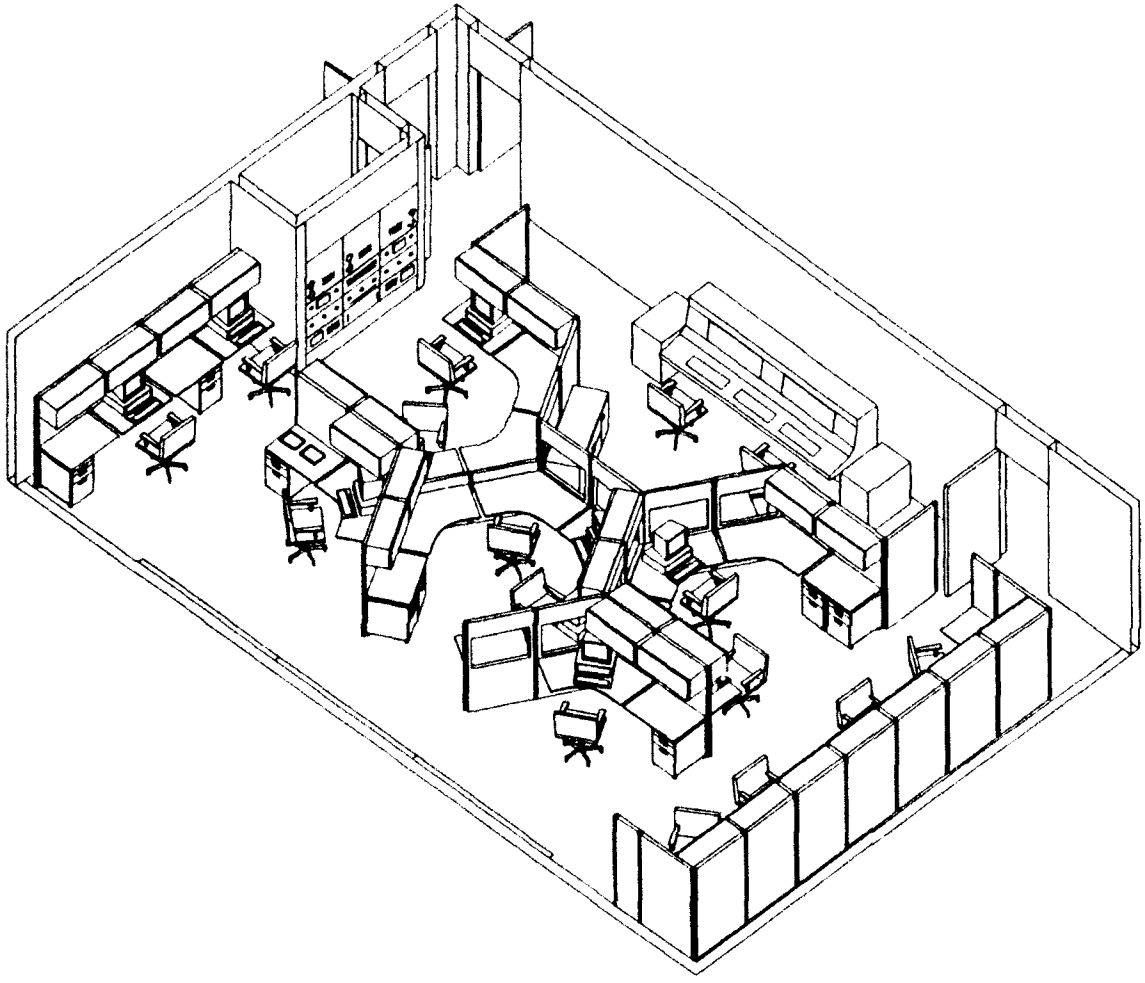
Equipment List

A. Senior officer workstation:
- Worksurface/console
- Bookshelves/file cabinets
- Ergonomic chair

B. Operations workstations (4-10)
- Custom consoles with built in communication, monitoring and information retrieval systems
- Reference shelving
- File storage
- Ergonomic seating

C. Emergency action console
D. TV system
E. WIN terminal(s)
F. Red/black phones
G. Terminals(s), printers(s)
H. Intercom system
I. NIDS/DISIDS
J. News service teleprinters
K. SATCOM/HF radio
L. COPREC
M. AMPE
N. Microcomputer system (LAN)
O. World clocks
P. Copy machine(s)
Q. Wall maps, charts, displays

guidance/facility component systems



• **Workstation component and seating adjustability for effective ergonomic interaction:**

1. Seating for virtually all positions, clerical, computer operator, technician, and supervisory, should be of the type that is adjustable to a range of tasks and individual needs. Adjustments should include seat height, backrest height, seat pan tilt, and backrest angle.
2. Machine and computer keyboard surfaces are especially important in terms of adjustability -- height, slope, and angle. Video display terminals must be placed at the proper viewing height and angle, along with being adjustable for individual operator needs. Worksurfaces must be located at the proper height for the specified task and be adjustable to suit individual occupant requirements. Suggested surface heights include:
   a. working/writing surface: 26"-31".
   b. machine interaction surface: 24"-27".
   c. computer keyboard surface: 24"-30".

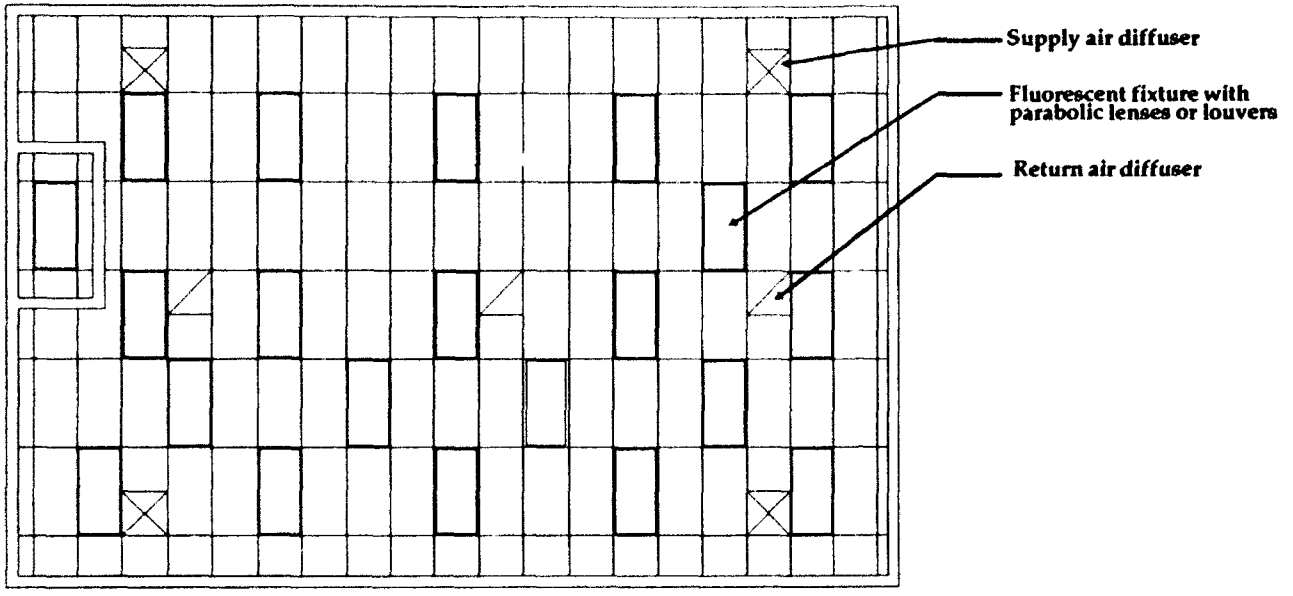
• **Effective separation and/or interconnectivity between personnel workstations:**

1. Divider partitions between workstations should be 60 inches high (+/-4 inches) to provide visual privacy while occupants are seated and yet not be confining.
2. A number of divider partitions between workstations should be able to be opened or closed as required to allow for either direct personnel interaction when open or for visual privacy when closed. These convertible partitions are especially relevant for hexagonal workstation configurations since each module has party partitions with several adjacent modules.

• **Adequate personnel workstation area and appropriate workstation locations:**

1. Provide the action officer (AO) workstation furniture as a continuous counter without any kneehole constraints. This allows for:
   a. maximum amount of desk-type worksurface area available.
   b. maximum choice of where AO and equipment can be located and/or co-located, especially when additional AOs are required to augment the assigned personnel for short time periods.

guidance/facility component systems



REFLECTED CEILING PLAN



• **Minimize reflected glare on VDT screens:**
1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.



• **Enable easy ceiling light fixture changes:**
1. It is intended that there will be periodic changes in the location of personnel workstations. The ceiling fluorescent light fixtures must be installed in a manner to allow for any fixture unit to be moved to an adjacent ceiling grid module in any direction.



• **Optimal building mechanical system for equipment protection:**
1. Independent air distribution system for electronic equipment spaces is needed.
2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.
3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall be used in electronic equipment cabinets.
4. Duct fire dampers shall be used in ducts that penetrate two-hour fire resistance-rated walls, partitions, shafts.



• **Impact of HVAC system noises on acoustical conditions:**
Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.

Policy/SOP

EA rooms are essential to any command that is associated with implementing the requirements and guidance contained in *Emergency Action Procedures, Volumes 1-7*. The EA room becomes the core cell in any command with nuclear command and control responsibility. This sole requirement drives the make-up of the space, the functions performed there across all spectrums of conflict, and the integration issues relative to all other command center spaces. Within each command center, policy has been established to govern center operations. The policy prescribes procedures that dictate:

1. Routine day-to-day operations and responsibilities.
2. Criteria for identifying minor crises and/or the emerging phases of more serious crises.
3. The limitations of authority and responsibility in handling crisis situations.
4. Notification procedures and command authority.
5. Informal means of augmenting the day-to-day operations personnel in response to minor crises.
6. Formal means of augmenting the day-to-day operations personnel by the activation of a Crisis Action Team (CAT).

NOTE:
The established policy within each command center may differ based upon the mission and AOR of that particular center. However, the generic framework for policy established herein should be sufficient to gain a working knowledge of the space.

C8
EMERGENCY ACTIONS ROOM

function

For the day-to-day collection and assessment of information to monitor all "221" traffic to ensure the command center's ability to respond to proper authorization and direction from the NCA to promptly and accurately execute the SIOP.

Space Subfunctions:

Situation monitoring for the collection of information about world events.
1c. Monitor environmental conditions.
d. Maintain locations and contacts with key CINC, government, and Allied personnel.
f. Provide aircraft and missle warning.
g. Identify nuclear detonations.

Force employment including special operations and SIOP operations.
7b. Provide weapon strike orders.
c. Provide for plan execution.
d. Coordinate execution initiation.

Force employment monitoring including the collection of information concerning the conduct of U.S. and Allied military missions and operations, determination of progress, measurement of results, and identification of shortfalls.
8j. Provide nuclear detonation information.

Hostilities termination assessment, evaluation, and order dissemination.
9a. Assess termination options, conditions, and proposals.

operations

1. Day-to-day EA operations:
- Monitor politically sensitive operations and military operations within the center's AOR.
- Provide operational reporting and briefings as necessary.
- Provide liaison with other government agencies.
- Provide coordination as required with:
  - Operations
  - Intelligence
  - Transportation
  - Logistics
  - Weather
  - Communications
  - Automated data processing
- Provide flag officer locations.
- Provide command duty officer function.

2. Minor crises or emerging phases of more serious crises:
- Provide identification of such phase or crisis.
- Provide for implementation of the center's emergency action procedures as required by the situation.
- Provide operational reporting and briefings as necessary.

Staff functions and responsibilities for the operation of this space	Primary responsibility for:	Receives input from:	Provides input to:	Performs at:
Personnel		●	●	
Intelligence		●	●	●
Operations	●	●	●	●
Logistics		●	●	
Plans		●		
Comm.-Electronics		●	●	●

Staff Participation:

Review of the subfunctions and operations associated with this space suggests this mix of functional staff participation. Note that these are generic allocations of staff participation to generically stated subfunctions and operations; they should only be used as initial concept development factors.

activities

1. Monitor current situation within the center's AOR.
2. Prepare messages, reports.
3. Present briefings.
4. Utilize communications system.
5. Maintain contact with other command centers.

personnel

- 1 senior officer (per shift)
- 1 NCOIC (per shift)
- 1 additional EA officer/EA-NCO
- 1 surveillance officer (this applies to those command centers that have a TW/AA capability)
- 2-4 communications personnel (per shift)

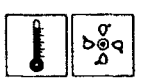
equipment

- Senior officer and NCOIC workstation:
  - Worksurface/console
  - File storage
  - Bookshelves
  - Ergonomic chair
- Workstations (2-4):
  - Custom consoles with built-in communication, monitoring, and information retrieval systems reference shelving
  - File storage
  - Ergonomic seating
- Emergency actions console
- TV system
- SIOP safes
- Red/black phones
- Terminal(s)/printer(s)
- Telephone/intercom system
- NIDS/DISIDS
- ARPCA
- AEPDS
- GWEN
- SATCOM/HF radio
- AMPE
- Microcomputer system (LAN)
- World clocks
- Copy machine(s)
- Wall maps, chart displays

notes

Operational Constraints:

The EA room is a "no-lone" zone. It must be configured to allow for complete security during SIOP and other compartmented actions. Access to communications and message processing equipment is essential for the EA team. Facility layout should facilitate ease of use and efficiency of motion.

requirements	criteria	commentary
1. Enough space to accommodate equipment and furniture associated with the Emergency Action Room.	1. Provide space for the monitoring of information systems, terminals, wire services, communications systems, and other equipment, and for operations personnel and supervisors as required by the command center. Space required for the EA Room typically ranges from 700 to 1000 sq. ft.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. A secure environment for the monitoring of sensitive/critical information during crisis and non-crisis situations.	2. The EA Room shall be located within the facility so that discussion and presentation of sensitive material in the space cannot be compromised. The access to the space must be controlled so that no one may enter without proper clearance. All appropriate equipment in the space must be TEMPEST certified.	2.  See TEMPEST section of the Security Systems in CCDH Volume 3 (page 7-33).
3. Interior finishes suitable for durability, maintenance, and room function.	3. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	3.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
4. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	4. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise (NC) should be between NC 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	4.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
5. Comfort features for the occupant such as chair and furniture systems comfort.	5. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	5.  See Seating section in CCDH Volume 3 (page 7-5).
6. Adequate lighting.	6. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	6.  See Interior Lighting in CCDH Volume 3 (page 7-55).
7. Adequate climate control.	7. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	7.  See HVAC section in CCDH Volume 3 (page 7-65).
8. Accessible power outlets.	8. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall. Provide a raised floor system that allows for easy access to power connections away from the walls.	8. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
9. Fire protection/life safety.	9. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	9.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

guidance/mission support for communication, information processing and briefing and display

• **Adequate numbers and quality of the secure/nonsecure telephone units:**
1. Calls to the telephones of key local and distant individuals are established within 10 seconds or less.
2. Voice clarity over all communication paths is equivalent to STU-111 clarity or better.
3. Provide "precedence" capability to assure the most important C3 messages get through first.

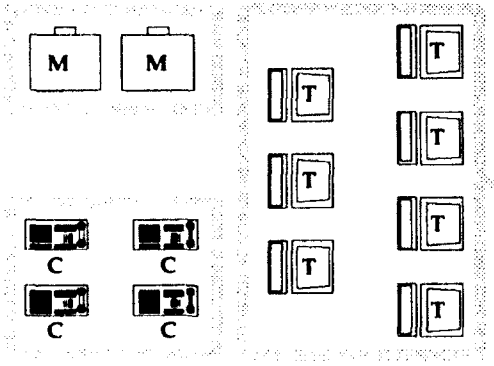
• **Provide optimal LAN connectivity between the command watch teams:**
1. Structure the LAN topology as "communities -of-interest" group LANs (e.g., CAT space, LCC space, Intel Center space that all have common interface during a crisis event).
2. Limit LAN briefing area applications to those that support command decision-making (e.g., JVIDS, mapping, message handling, database management).

Briefing and Display Subsystem Requirements:
1. Closed circuit TV system to monitor and control SCIF entrances.
2. Display of personnel tracking system.

M = LSD monitor

Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.
4. Access to multi-dimensional message service, including electronic mail and file transfers.
5. Access to internal and external facsimile connections that have multi-level-security.

C = communications handset



• **Automated Emergency Action Message Processing and Dissemination System (AEPDS):**
1. All EA watch members should have an interactive multi-workstation AEPDS terminal available.

Information Processing Subsystem Requirements:
1. Access to a multi-dimensional information processing system that includes:
a. automated message handling system (AMHS)
b. multi-media management and storage system
c. text archival/retrieval system
d. mapping system
e. multi-level security (MLS) gateways
f. distributed processing and heterogenous platform connectivity
2. Computer terminals, connected to all relevant command watch teams, e.g., CSS, Intel, Ops, Logistics, etc.

T = computer terminal

• **Adequate communication switching capacity:**
1. The internal and external communication connectivity needs to be optimal during peak crisis periods. Lead team personnel should have state-of-the-art console access.

• **Adequate numbers and quality of computer terminals:**
1. Necessary types of information (e.g.,messages, maps, TV news) can be sent and received.
2. Undetected data errors are negligible.
3. A computer file that is needed quickly (e.g., a photo) can be delivered electronically within one minute to destinations inside the command center and within 10 minutes to remote destinations.

• **Minimize numbers of handsets required:**
1. Use red/black interface phones to eliminate the need for multiple handsets.
2. Provide phone handsets with user-friendly single/multiple channel control buttons and with a "message window" that indicates the classification level of the call connection.

• **Optimum interoperability of the LAN:**
1. In order to take advantage of the IPS currently available, the commands' LAN system will require a UNIX-based platform, and should be compliant with GOSIP, X Window, and Motif standards.
2. AO's connected to the command LAN require terminals similar to UNIX-based integrated workstations.
3. In order to support operations, the LAN requires several laser printers with a minimum of 2 MB of random access memory (RAM).

• **Defense Message System (DMS):**
1. The DMS will allow for the necessary message service, electronic mail, and file transfer interoperability between EA teams throughout all commands.

• **Adequate facsimile capability:**
1. Provide both non-secure and secure facsimile machines with at least one spare machine available at each level.
2. Tie in the FAX capability with the LAN system to take advantage of LAN scanner, printers, etc.

guidance/facility component systems

• Space located so the personnel can securely and efficiently interact with others -- especially during crisis events:

1. This functional space should be located within the core of a command center. The desired location is adjacent to or near the Crisis Action Team space.
2. Typical crisis event activities require that this functional space be located within a SCIF.

• Acceptable travel distance within the space to the nearest door during a fire:

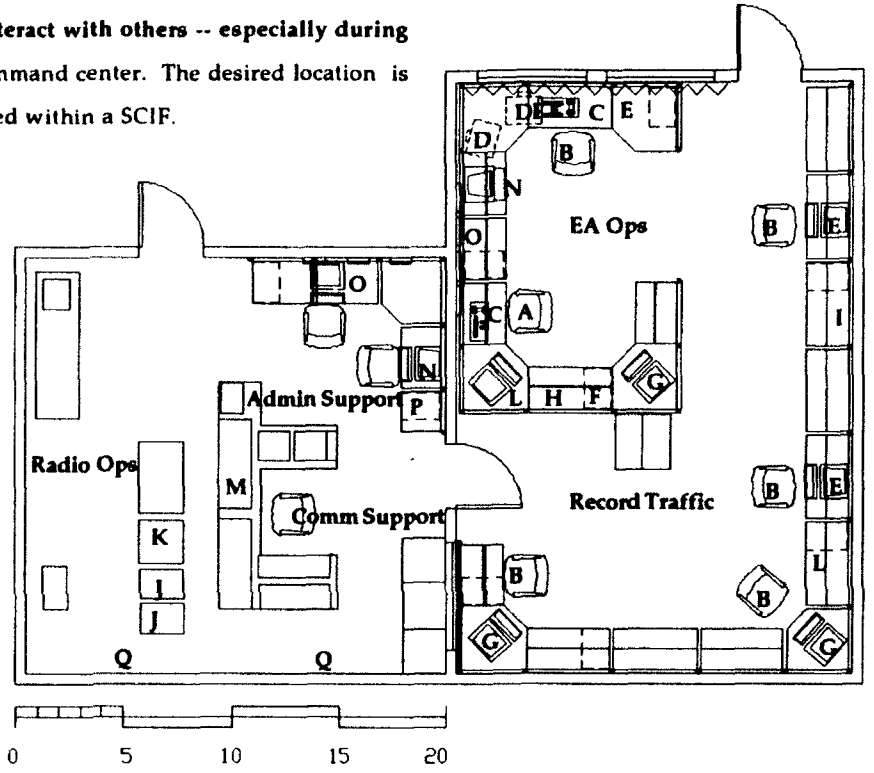
1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)
2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.

• Workstation component and seating adjustability for effective ergonomic interaction:

1. Seating for virtually all positions, clerical, computer operator, technician, and supervisory, should be of the type that is adjustable to a range of tasks and individual needs. Adjustments should include seat height, backrest height, seat pan tilt, and backrest angle.
2. Machine and computer keyboard surfaces are especially important in terms of adjustability -- height, slope, and angle. Video display terminals must be placed at the proper viewing height and angle, along with being adjustable for individual operator needs. Worksurfaces must be located at the proper height for the specified task and be adjustable to suit individual occupant requirements. Suggested surface heights include:
   a. working/writing surface: 26"-31".
   b. machine interaction surface: 24"-27".
   c. computer keyboard surface: 24"-30".

• Acceptable travel distance to the nearest building exit during a fire:

1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)



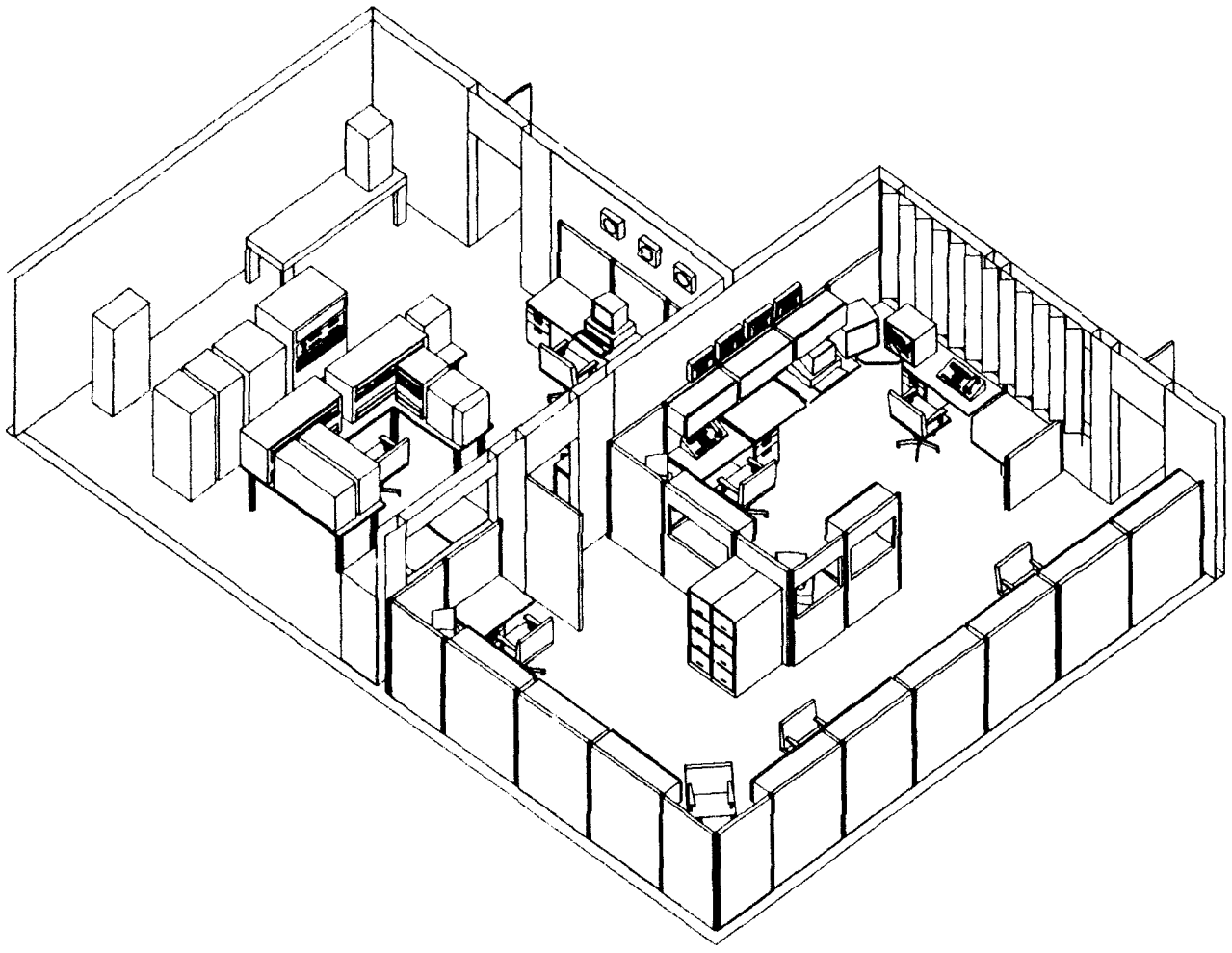
Equipment List

A. Senior Officer and NCOIC workstation:
- Worksurface/console
- Bookshelves/file cabinets
- Ergonomic chair

B. Workstations (2-4):
- Custom consoles with built in communication, monitoring, and information retrieval systems
- Reference shelving
- File storage
- Ergonomic seating

C. Emergency actions console
D. CCTV system
E. SIOP safes
F. Red/black phones
G. Terminal(s)/printer(s)
H. Telephone/intercom system
I. NIDS/DISIDS
J. ARPCA
K. GWEN
L. AEPDS
M. AMPE
N. Microcomputer system (LAN)
O. World clocks
P. Copy machine(s)
Q. Wall maps, charts, displays
R. SATCOM/HF radio

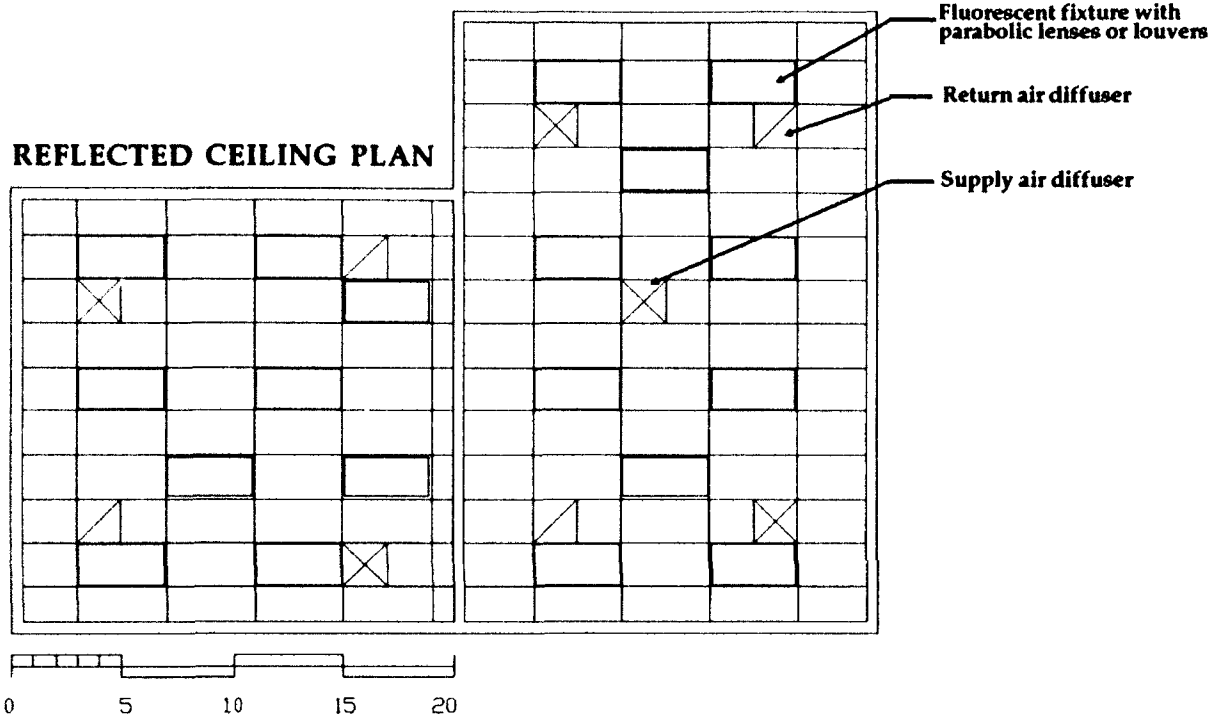
guidance/facility component systems



• **Impact of HVAC system noises on acoustical conditions:** Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.

guidance/facility component systems

REFLECTED CEILING PLAN



• **HVAC mechanical system to adequately accommodate electronic-generated heat loads:**

1. Heat dissipation by computers, radios, and other electronic equipment is relatively constant; therefore, cooling is required year-round. The room sensible-heat ratio is near unity because heat generated by the computer system is all sensible.
2. The number of required air changes per hour should be 10 to 20 because of the equipment's high heat generation.
3. Humidity control is required year-round to maintain necessary conditions. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components.

• **Enable easy ceiling light fixture changes:**

1. It is intended that there will be periodic changes in the location of personnel workstations. The ceiling fluorescent light fixtures must be installed in a manner to allow for any fixture unit to be moved to an adjacent ceiling grid module in any direction.

• **Minimize reflected glare on VDT screens:**

1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

Policy/SOP

Individual command center policy will dictate the criteria that will necessitate the forming of an Operational Planning Group (OPG) and activation of the Special Operations Center (SOC). The Special Operations Center will remain in a state of readiness for use at any time an Operational Planning Group is established. Systems and equipment within the SOC will be maintained and tested periodically according to established maintenance policy and manufacturer's recommendations. Because of the nature of the activities and type of information in use within the SOC, it must be able to function at the SCI level. The location of the SOC should be such that uninformed personnel should not be able to see if an OPG has been formed or if the SOC is in operation. The type of information handled by the OPG often requires two-person control.

C9
SPECIAL OPERATIONS CENTER/OPG

function

For the centralized focus of an ad hoc group established for the purpose of resolving a specific problem or accomplishing a specific task, typically within a short time frame.

Space Subfunctions:

2a. Monitor, determine, and display the status of readiness of all U.S. forces and resources (F/R) (including active and reserve elements) and non-U.S. F/R worldwide (including nuclear force status and weapons).
b. Identify and display unit, resources, facilities, communications, and weapons, system characteristics and capabilities, planning factors, and performance data.
c. Identify critical logistic resources.
d. Identify the location and status of aircraft and sealift assets.
e. Assess force operational readiness capability and availability; identify the deployability status of designated forces.

3a. Assess U.S. force/resource status relative to non-U.S. F/R status.
b. Determine military implications of intelligence indicators and enemy order of battle (EOB).
c. Assess events relative to U.S. policies, treaties, interests, etc., and impacts on U.S. (military) operations.
d. Establish the nature of hostilities and crises and assess their impact.
e. Determine U.S., Allied, and friendly capability to contain the situation.
f. Determine implications of U.S. involvement.
g. Evaluate changes in the status of the civil sectors.
h. Develop combined operations/intelligence situation assessment and briefing.
i. Determine net situation assessment.
j. Support the determination that an attack is in progress and provide an assessment of the nature of the attack.

4a. Formulate operations objectives and schedule resource utilization.
b. Generate and refine F/R requirements and options, movement requirements, resupply and non-unit personnel requirements.
c. Merge, modify, and tailor force lists and force movement requirements to crisis operations.
d. Develop and evaluate potential courses of action (COA), including the definition of COAs and operations for situations that may require the use of U.S. military forces. COA development is normally very time-sensitive and involves the determination of forces, logistics support, personnel, and transportation requirements to support contingencies for which no plans exist.

function

e. Match and select COA/OPLAN force and movement requirements with actual forces and resources, and allocate forces and resources to plans. Includes use of U.S. and/or Allied military forces and material, and host nation support.
f. Determine and allocate F/R to special logistics requirements such as engineering, POL, ammunition, medical, and other critical areas, as applicable.
g. Perform plan analysis; determine COA/OPLAN force logistics and transportation availability and feasibility. Identify logistics, transportation, and personnel shortfalls; assess adequacy of plans to achieve objectives, considering intelligence inputs.
h. Assess projected capabilities to satisfy sustainment requirements for long-range COAs and contingency operations.
m. Present plans to decision makers.

7a. Determine intercept profiles to assign targets.
b. Provide weapon strike orders.
c. Provide for plan execution.
d. Coordinate execution initiation.
e. Perform force/sortie launch.
f. Reconstitute and redirect forces.
g. Perform retargeting.

9a. Assess termination options, conditions, and proposals.
b. Determine implications of termination.
c. Assess feasibility of termination; determine degree to which objectives have been achieved.
d. Define terms of termination.
f. Support negotiations.
g. Brief NCA, CINCs, commanders on plan execution/termination, progress and results.
h. Prepare, coordinate and disseminate operations termination orders.

operations

1. Provide rapid means of resolution of a specific task or problem.
2. Provide central coordination point for all activities related to the assigned task.
3. Provide direct, immediate support to the commander or the Battle Staff.
4. Provide secure means of conducting crisis planning during non-crisis periods.
5. Provide briefings and decisions as required by other command center elements.

Staff functions and responsibilities for the operation of this space	Primary responsibility for:	Receives input from	Provides input to	Performs at
Personnel				
Intelligence		●	●	●
Operations	●	●	●	●
Logistics		●		●
Plans		●		●
Comm.-Electronics		●		

Staff Participation:

Review of the subfunctions and operations associated with this space suggests this mix of functional staff participation. Note that these are generic allocations of staff participation to generically stated subfunctions and operations; they should only be used as initial concept development factors.

activities

1. Prepare briefings.
2. Prepare plans.
3. Make recommendations.
4. Prepare messages.
5. Gather/compile data.
6. Perform coordination.
7. Utilize communications.

personnel

- 1 senior officer
- Others as required by the specific task (number usually does not exceed 10)

equipment

- OPG member workstations:
  - Worksurface with storage
  - Ergonomic chair
- Terminal workstations (as necessary)
  - Machine surface with keyboard support
  - Printer stand (if required)
  - Ergonomic chair
- Group work area for up to 10 people
- Communications support through CWO at selected workstations:
  - Commercial
  - Autovon
  - Red switch
  - Intercom
  - PA system
- Whiteboard/display surface
- Projection screen
- World clocks
- Lectern with display controls
-
- Safe for cryptographic material

requirements	criteria	commentary
1. Enough space to accommodate the equipment and personnel associated with the Special Operations Center and necessary to accomplish the specific function of the Operational Planning Group.	1. Space shall be provided to allow for the planning and solution development associated with the resolution of a specific task assignment and the formation of an OPG. The space may be further partitioned by the use of partial height panels to delineate individual workstations. The actual space will depend upon the individual command center, but will generally fall within the range of 1500 to 2000 sq. ft.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. A secure environment for the monitoring of sensitive/critical information during crisis and non-crisis situations.	2. The Special Operationss Center shall be located within the facility so that discussion and presentation of sensitive material in the space cannot be compromised. The access to the space must be controlled so no one may enter without proper clearance. All appropriate equipment in the space must be TEMPEST certified.	2.  See TEMPEST section of the Security Systems in CCDH Volume 3 (page 7-33).
3. Interior finishes suitable for durability, maintenance, and room function.	3. ***Floors*** Anti-static carpet in roll goods or tiles over hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	3.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
4. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	4. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise (NC) should be between NC 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	4.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
5. Comfort features for the occupant such as chair and furniture systems comfort.	5. Provide each workstation maximum adjustability, such as chairs with seat height adjustment, and workstation components that all have height adjustments.	5.  See Seating section in CCDH Volume 3 (page 7-5).
6. Adequate lighting.	6. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	6.  See Interior Lighting in CCDH Volume 3 (page 7-55).
7. Adequate climate control.	7. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	7.  See HVAC section in CCDH Volume 3 (page 7-65).
8. Accessible power outlets.	8. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall. Provide a raised floor system that allows for easy access to power connections away from the walls.	8. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
9. Fire protection/life safety.	9. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	9.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

guidance/mission support systems for communication, information processing, and briefing display

• **Provide optimal LAN connectivity between the command watch teams:**
1. Structure the LAN topology as "communities -of-interest" group LANs (e.g., CAT space, LCC space, Intel Center space that all have common interface during a crisis event).
2. Limit LAN briefing area applications to those that support command decision-making (e.g., JVIDS, mapping, message handling, database management).

• **Optimum interoperability of the LAN:**
1. In order to take advantage of the IPS currently available, the commands' LAN system will require a UNIX-based platform, and should be compliant with COSIP, X Window, and Motif standards.
2. AO's connected to the command LAN require terminals similar to UNIX-based integrated workstations.
3. In order to support operations, the LAN requires several laser printers with a minimum of 2 MB of random access memory (RAM).

• **Convenient local control of LSD images:**
1. Individual keypad or touchscreen local controller to simplify image selection.
2. Local selection of images may be by controller located on podium, however an alternative method of image selection is advisable when briefers do not wish to control images.
3. Requested images should be displayed in acceptable real time of typically 2 to 5 seconds.

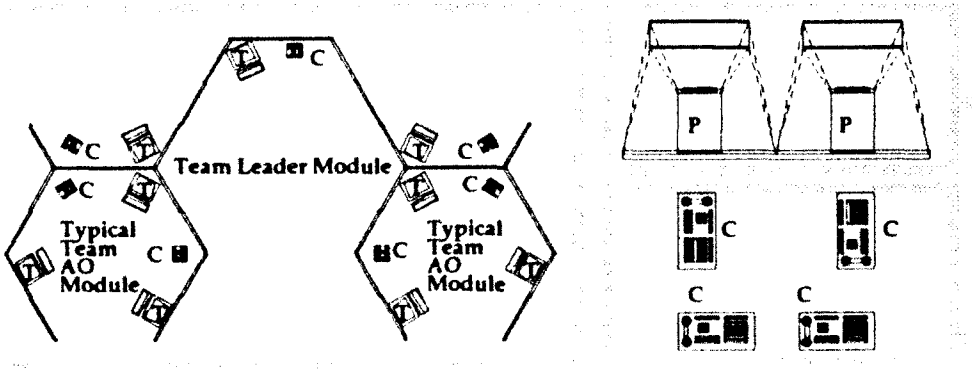
• **Adequate facsimile capability:**
1. Provide both non-secure and secure facsimile machines with at least one spare machine available at each level.
2. Tie in the FAX capability with the LAN system to take advantage of LAN scanner, printers, etc.

Briefing and Display Subsystem Requirements:
1. Large-screen projection units, either rear-screen units in an adjacent room or self-contained units within the space.
2. Audio amplification system with interconnection to other watch and briefing spaces.
3. Display control console, internal or in an adjacent space for local selection of display images.
4. Large flat-panel alphanumeric displays, employing plasma technology, to be use to provide general message information.

P = rear screen projectors

Information Processing Subsystem Requirements:
1. Access to a multi-dimensional information processing system that includes:
a. automated message handling system (AMHS)
b. multi-media management and storage system
c. text archival/retrieval system
d. mapping system
e. multi-level security (MLS) gateways
f. distributed processing and heterogenous platform connectivity
2. Computer terminals, connected to all relevant command watch teams, e.g., CSS, Intel, Ops, Logistics, etc.

T = computer terminal



• ***Adequate size and quality of LSD images based on distance to primary viewers:***
1. Up to three large screen displays, with screen sizes 6 to 8 feet wide.
2. CRT LSD projectors offer highest performance/price tradeoff. For 6 to 8 foot wide displays, projectors employing 7 or 8 inch CRTs will provide adequate displays in a medium-to-low light level room. If rear-screen projection is not possible, consider self-contained projection units.)
3. Digital convergence projectors should be selected.

• **Adequate numbers and quality of the secure/nonsecure telephone units:**
1. Calls to the telephones of key local and distant individuals are established within 10 seconds or less.
2. Voice clarity over all communication paths is equivalent to STU-111 clarity or better.
3. Provide "precedence" capability to assure the most important C3 messages get through first.

Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.
4. Access to multi-dimensional message service, including electronic mail and file transfers.
5. Access to internal and external facsimile connections that have multi-level-security.

C = communications handset

• **Adequate numbers and quality of computer terminals:**
1. Necessary types of information (e.g.,messages, maps, TV news) can be sent and received.
2. Undetected data errors are negligible.
3. A computer file that is needed quickly (e.g., a photo) can be delivered electronically within one minute to destinations inside the command center and within 10 minutes to remote destinations.

• **Adequate communication switching capacity:**
1. The internal and external communication connectivity needs to be optimal during peak crisis periods. Lead team personnel should have state-of-the-art console access.

guidance/facility component systems

• Space located so the personnel can securely and efficiently interact with others -- especially during crisis events:

1. This functional space should be located within the core of a command center. The desired location is adjacent to or near the Crisis Action Team space.
2. Typical crisis event activities require that this functional space be located within a SCIF.

• Acceptable travel distance within the space to the nearest door during a fire:

1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)
2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.

• Acceptable travel distance to the nearest building exit during a fire:

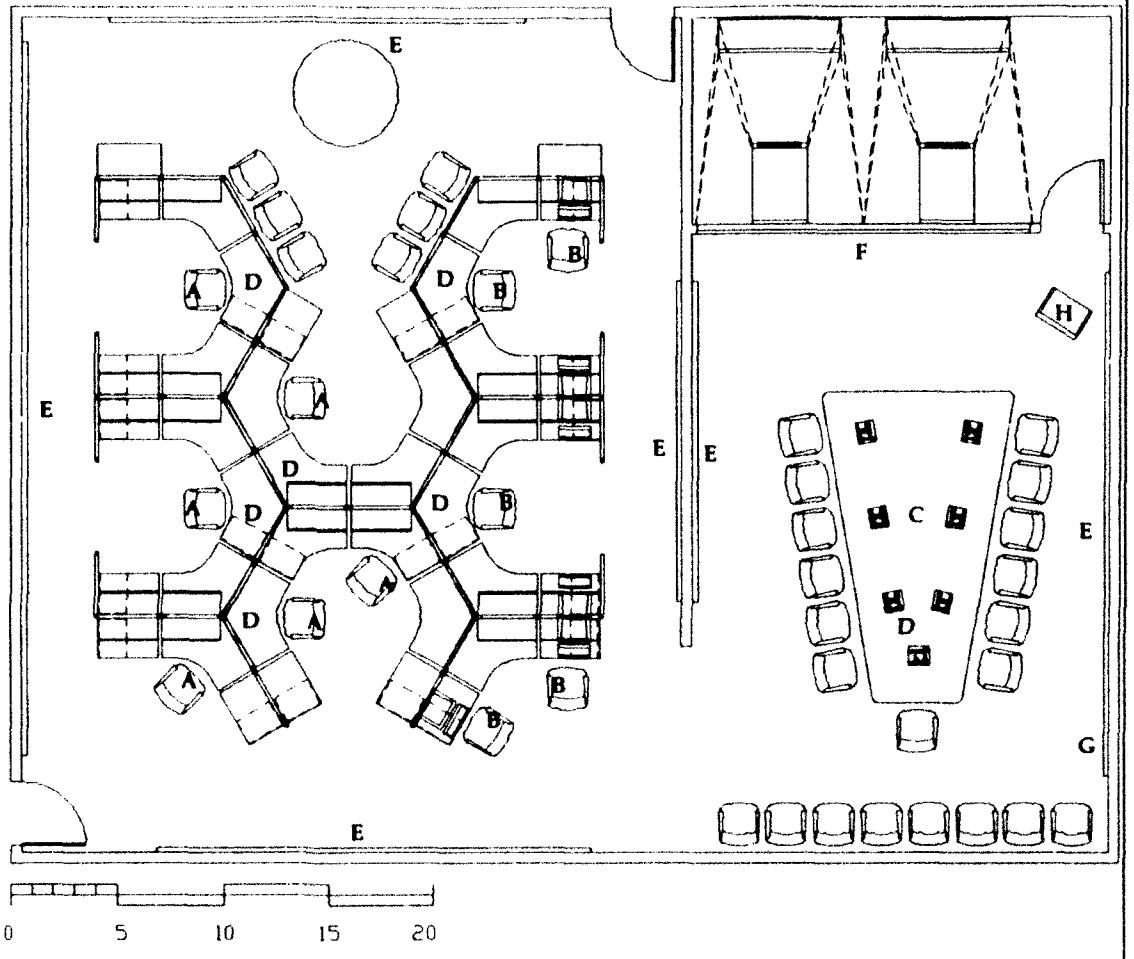
1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)

• Optimal choice for the rearrangement of personnel workstation modules:

1. To maintain a responsive, efficient work environment, space management should be localized with the first supervisors. Local planning and management are needed to retain equitable space allocation, to maintain previously established standards, and to respond efficiently to changing situations.

• Workstation component and seating adjustability for effective ergonomic interaction:

1. Seating for virtually all positions, clerical, computer operator, technician, and supervisory, should be of the type that is adjustable to a range of tasks and individual needs. Adjustments should include seat height, backrest height, seat pan tilt, and backrest angle.
2. Machine and computer keyboard surfaces are especially important in terms of adjustability -- height, slope, and angle. Video display terminals must be placed at the proper viewing height and angle, along with being adjustable for individual operator needs. Worksurfaces must be located at the proper height for the specified task and be adjustable to suit individual occupant requirements. Suggested surface heights include:
   a. working/writing surface: 26"-31".
   b. machine interaction surface: 24"-27".
   c. computer keyboard surface: 24"-30".



Equipment List

A. OPG member workstations:
- Worksurface with storage
- Ergonomic chair

B. Terminal workstations (as necessary)
- Machine surface with keyboard support
- Printer stand (if required)
- Ergonomic chair

C. Group work area for up to 10 people

D. Communications support thru CWO at selected workstations:
- Commercial
- Autovon
- Red switch
- Intercom
- PA system

E. Whiteboard/display surface

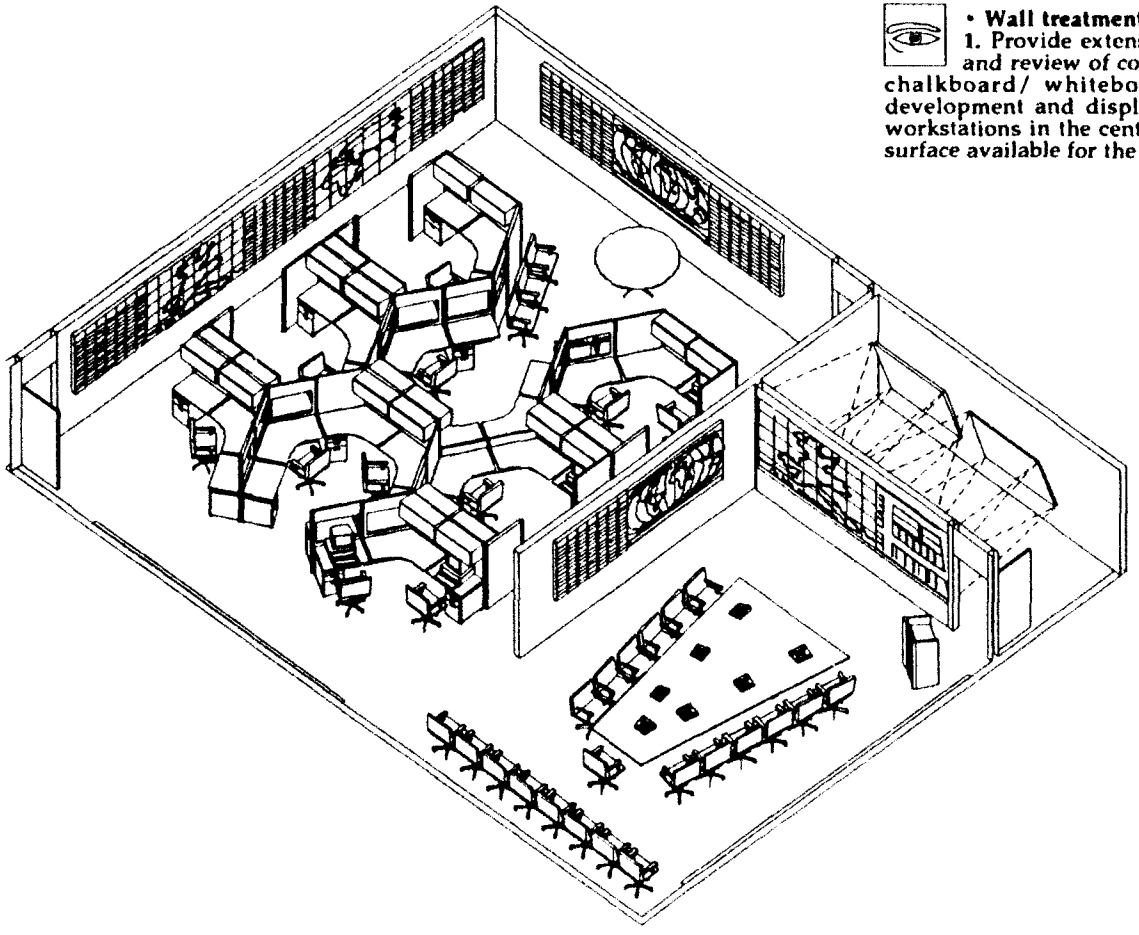
F. Projection screen

G. World clocks

H. Lectern with display controls

I. Crypto safes

guidance/facility component systems



• **Wall treatment for effective graphic displays:**
1. Provide extensive perimeter wall space to allow for the display and review of completed graphic displays. In addition, a 72" x 48" chalkboard/ whiteboard should be periodically provided for the development and display of conceptual ideas. Arranging the personnel workstations in the center of the space makes much of the perimeter wall surface available for the required graphic display and whiteboards.

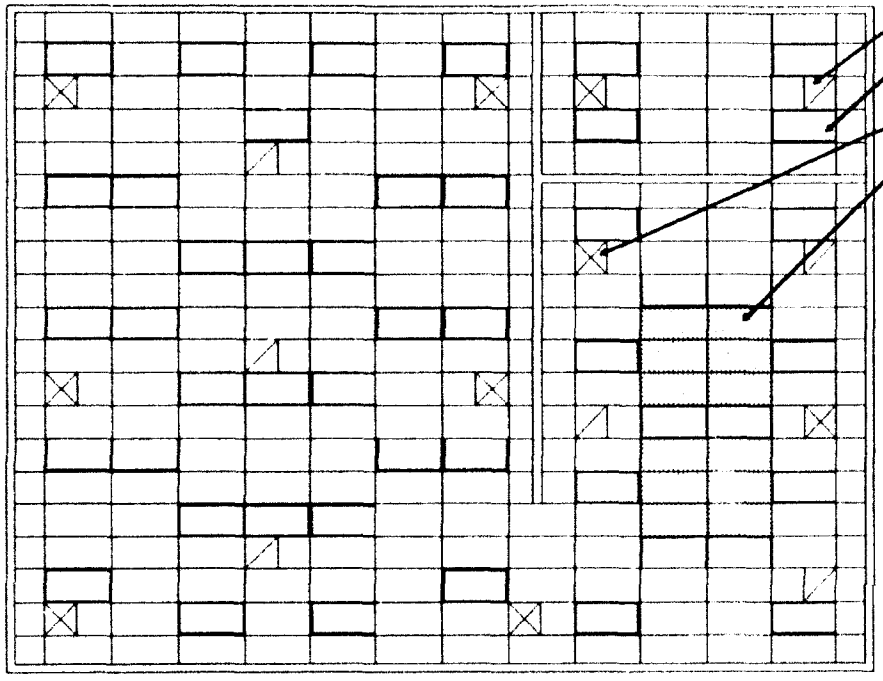
• **Adequate personnel workstation area and appropriate workstation locations:**
1. Provide the action officer (AO) workstation furniture as a continuous counter without any kneehole constraints. This allows for:
a. maximum amount of desk-type worksurface area available.
b. maximum choice of where AO and equipment can be located and/or co-located, especially when additional AOs are required to augment the assigned personnel for short time periods.

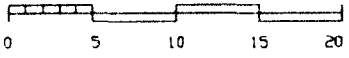
• **Coordination of graphic *presentations by briefers:***
The briefers' lectern should contain the necessary communication connectivity to control the automated presentations and/or the necessary communication connection to those who do manual presentations. Such controls must be simple and obvious, since the briefers must primarily concentrate on text. (Ambient lighting controls should be on the room walls adjacent to the lectern rather than being on the lectern itself.)

• **Effective separation and/or interconnectivity between personnel workstations:**
1. Divider partitions between workstations should be 60 inches high (+/-4 inches) to provide visual privacy while occupants are seated and yet not be confining.
2. A number of divider partitions between workstations should be able to be opened or closed as required to allow for either direct personnel interaction when open or for visual privacy when closed. These convertible partitions are especially relevant for hexagonal workstation configurations since each module has party partitions with several adjacent modules.

• **Optimal individual choice for the extent and location of the componentry in personnel workstation modules:**
1. Provide personnel workstations using system furniture componentry with a single modular dimension of 36". This allows for:
a. easy rearrangement of all components since they will always be compatible with each other.
b. easy removal of individual desk unit components to accommodate floor-mounted equipment, and then the possible replacement of desk units when the equipment is eventually developed as desktop models. Personnel workstations using system furniture 36" components can be configured as either rectangular or hexagonal modules. The hexagonal modules are recommended for this space.

guidance/facility component systems





REFLECTED CEILING PLAN

• Minimize reflected glare on VDT screens:
1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

• Enable easy ceiling light fixture changes:
1. It is intended that there will be periodic changes in the location of personnel workstations. The ceiling fluorescent light fixtures must be installed in a manner to allow for any fixture unit to be moved to an adjacent ceiling grid module in any direction.

• Optimal building mechanical system for equipment protection:
1. An independent air distribution system for electronic equipment spaces is needed.
2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.
3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall be used in electronic equipment cabinets.
4. Duct fire dampers shall be used in ducts that penetrate two-hour fire resistance-rated walls, partitions, shafts.

• Room acoustic conditions determined by audio system designs:
1. For meeting-type rooms a successful microphone/speaker system depends upon the surface treatment in the room itself. Both the floor and walls should be covered with sound-absorbing materials. The ceiling surface, however, should be reflective over the conference table area and over the observer seating areas.

• Optimal acoustic conditions during high activity periods:
1. In order to provide the best working environment within operations spaces that can accommodate up to 30 or 40 persons at one time, it is suggested that the ceiling surface and available wall surface, where practical, be treated with sound-absorbing material. This treatment will allow for the maximum control of within-room noise levels.

• Impact of HVAC system noises on acoustical conditions:
Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important./

• Adequate brightness of projected graphics:
A rear-screen projector with a minimum output of 1000 lumens is recommended for an approximately eight-foot-wide image. Reducing the screen width to approximately six feet permits the use of projectors with a brightness of 600 lumens. WARNING: Large-screen projector images of highly detailed graphics may have limited legibility no matter how bright they are.

Policy/SOP

The Intelligence Center is in operation continuously. It is staffed by an operations team during day-to-day operations. In the event of a crisis, the team will be augmented to respond as necessary to the Crisis Action Team. Due to the nature of the information being collected, the center shall be physically secured and entry controlled.

C10
INTELLIGENCE CENTER

function

For the central focus of all source intelligence-gathering activities and the compilation and distribution of said intelligence information.

Space Subfunctions:

1a. Receive, maintain, integrate, and display data from external systems, e.g. State Department, Intelligence.
b. Monitor status of global actions, critical events, natural disasters, crisis areas, political/diplomatic/economic developments, non-U.S. military operations, etc.
c. Monitor environmental conditions.
d. Maintain locations and contacts with key CINC, government, and Allied personnel.
e. Monitor U.S. policies (ROE), treaties, agreements, etc.
f. Provide aircraft and missile warning.
g. Identify nuclear detonations.
h. Direct and task surveillance systems.

3b. Determine military implications of intelligence indicators and enemy order of battle (EOB).
c. Assess events relative to U.S. policies, treaties, interests, etc., and impact on U.S. (military) operations.
d. Establish the nature of hostilities and crises and assess their impact.
h. Develop combined operations/intelligence situation assessment and briefing.
i. Determine net situation assessment.
j. Support the determination that an attack is in progress and provide an assessment of the nature of the attack.

7g. Perform retargeting.

8i. Provide bomb damage information, weapon strike data; assess U.S., Allied, and enemy operations and strike results.
j. Provide nuclear detonation information.

9b. Determine implications of termination.

operations

1. Provide a single point for the collection and compilation of intelligence information from a variety of sources.
2. Provide intelligence reports developed by composite intelligence specialists.
3. Provide intelligence briefings as required in support of day-to-day or crisis situations.
4. Provide response to CAT or Battle Staff requests as required.

Staff functions and responsibilities for the operation of this space	Primary responsibility for:	Receives input from:	Provides input to:	Performs at:
Personnel				
Intelligence	●			
Operations		●	●	
Logistics		●		
Plans				
Comm.-Electronics		●	●	

Staff Participation

Review of the subfunctions and operations associated with this space suggests this mix of functional staff participation. Note that these are generic allocations of staff participation to generically stated subfunctions and operations; they should only be used as initial concept development factors.

activities

1. Receive intelligence information from a host of sources.
2. Compile information into a usable form.
3. Prepare intelligence reports for briefing and decision-making.
4. Brief other command center elements as needed.
5. Distribute information to other elements.

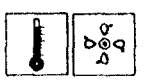
personnel

- 1 Chief of Intelligence Center
- 1 NCOIC (per shift)
- 1 DIA representative
- 8-10 intelligence specialists (per shift)

equipment

- Chief's workstation:
  - Worksurface with storage
  - File cabinet/bookcase
  - 2 visitors chairs
  - Ergonomic chair
- DIA representative's workstation:
  - Worksurface with storage
  - File cabinet
  - Ergonomic chair
- NCOIC/intelligence specialist's workstation:
  - Worksurface with storage
  - File cabinet/bookcase
  - Ergonomic chair
- Intelligence briefing setup:
  - Group work area
  - Seating for 8
  - Classified material storage
  - Whiteboard/display surface
- Full communications support:
  - Autovon
  - Commercial
  - Red switch
  - Intercom/PA system
- Group work area for up to 5 people
- Maps, charts
- Storage for maps, charts
- Classified material containers
- Link with applicable information databases
- News service teleprinters
- Electrostatic printer
- Copier(s)
- TV monitor
- Cryptographic equipment
- Microfilm reader
- Microcomputer with printer
- World clocks

notes

requirements	criteria	commentary
1. Enough space to accommodate the personnel and equipment associated with the function of the Intelligence Center.	1. The amount of space necessary to house the intelligence Center will, of course, vary with the number of people assigned and the scope of the Intelligence mission at the command center. The area may be subdivided into additional spaces as necessary, but will generally require 1200 to 1400 sq. ft.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. A secure environment for the monitoring of sensitive/critical information during crisis and non-crisis situations.	2. The Intelligence Center area shall be located within the facility so that discussion and presentation of sensitive material in the space cannot be compromised. The access to the space must be controlled so that no one may enter without proper clearance. All appropriate equipment in the space must be TEMPEST certified.	2.  See TEMPEST section of the Security Systems in CCDH Volume 3 (page 7-33).
3. Interior finishes suitable for durability, maintenance, and room function.	3. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	3.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
4. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	4. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise (NC) should be between NC 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	4.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
5. Comfort features for the occupant such as chair and furniture systems comfort.	5. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	5.  See Seating section in CCDH Volume 3 (page 7-5).
6. Adequate lighting.	6. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	6.  See Interior Lighting in CCDH Volume 3 (page 7-55).
7. Adequate climate control.	7. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	7.  See HVAC section in CCDH Volume 3 (page 7-65).
8. Accessible power outlets.	8. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall. Provide a raised floor system that allows for easy access to power connections away from the walls.	8. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
9. Fire protection/life safety.	9. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	9.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

guidance/mission support systems for communication and information processing

• **Minimize numbers of handsets required**:
1. Use red/black interface phones to eliminate the need for multiple handsets.
2. Provide phone handsets with user-friendly single/multiple channel control buttons and with a "message window" that indicates the classification level of the call connection.

• **Adequate communication switching capacity**:
1. The internal and external communication connectivity needs to be optimal during peak crisis periods. Lead team personnel should have state-of-the-art console access.

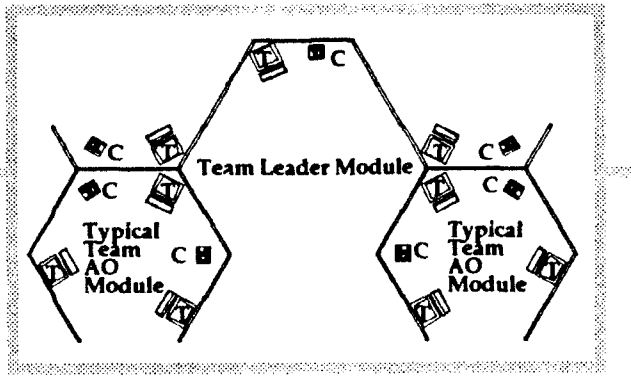
• **Adequate facsimile capability**:
1. Provide both non-secure and secure facsimile machines with at least one spare machine available at each level.
2. Tie in the FAX capability with the LAN system to take advantage of LAN scanner, printers, etc.

• **Provide optimal LAN connectivity between the command watch teams:**
1. Structure the LAN topology as "communities -of-interest" group LANs (e.g., CAT space, LCC space, Intel Center space that all have common interface during a crisis event).
2. Limit LAN briefing area applications to those that support command decision-making (e.g., JVIDS, mapping, message handling, database management).

• **Optimum interoperability of the LAN**:
1. In order to take advantage of the IPS currently available, the commands' LAN system will require a UNIX-based platform, and should be compliant with GOSIP, X Window, and Motif standards.
2. AO's connected to the command LAN require terminals similar to UNIX-based integrated workstations.

Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.
4. Access to multi-dimensional message service, including electronic mail and file transfers.
5. Access to internal and external facsimile connections that have multi-level-security.

C = communications handset



Information Processing Subsystem Requirements:
1. Access to a multi-dimensional information processing system that includes:
a. automated message handling system (AMHS)
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Necessary types of information (e.g.,messages, maps, TV news) can be sent and received.
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guidance/facility component systems

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1. This functional space should be located within the core of a command center. The desired location is adjacent to or near the Crisis Action Team space.
2. Typical crisis event activities require that this functional space be located within a SCIF.

Some commands may need to locate the coordination/planning activities in a separate adjacent space if the information discussed and displayed is routinely top secret

• Effective relationship of lead personnel to staff:

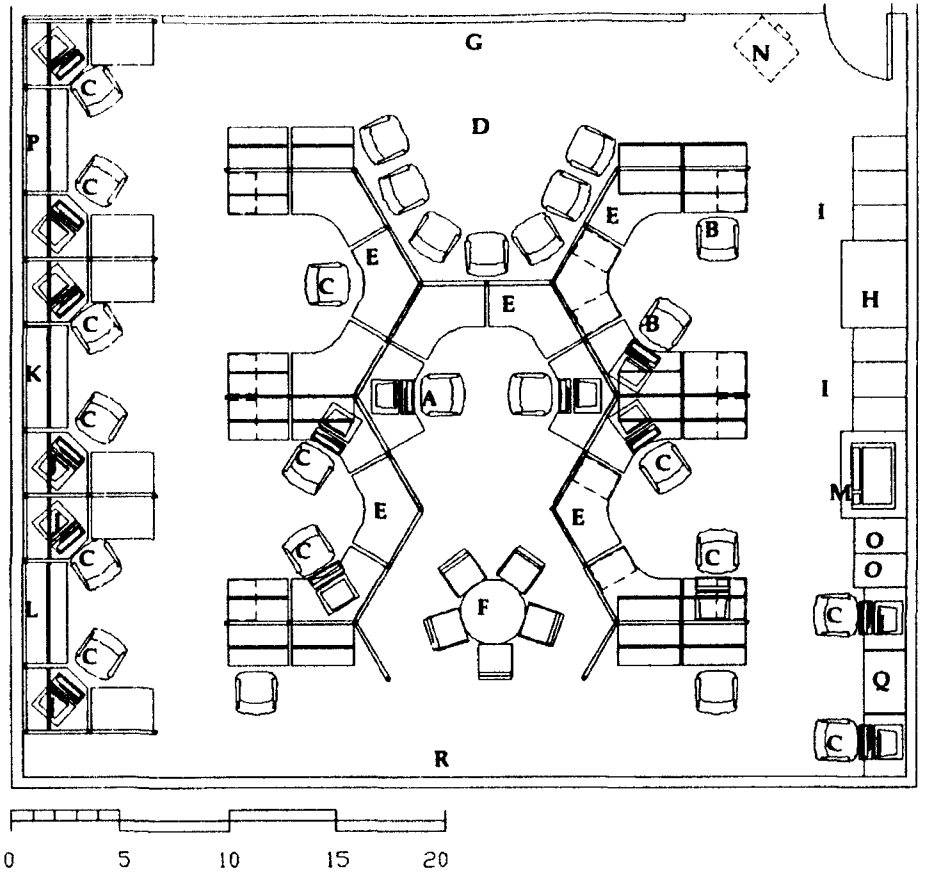
1. Locate the senior person(s) at the center of the operational workstations -- with a maximum of 20 to 25 feet from the farthest workstations (and/or display screens).

• Effective conferencing activities for group coordination and planning:

1. Provide conference table and chairs adjacent to lead personnel workstation.
2. Provide whiteboard display surface with mounting ledge (approx. 96" x 48").

• Optimal choice for the rearrangement of personnel workstation modules:

1. To maintain a responsive, efficient work environment, space management should be localized with the first supervisors. Local planning and management are needed to retain equitable space allocation, to maintain previously established standards, and to respond efficiently to changing situations.



Equipment List

A. Chief's workstation:
- Worksurface with storage
- Bookshelve(s)/file cabinet(s)
- 2 visitor's chairs
- Ergonomic chair(s)

B. DIA Representative's workstation:
- Worksurface with storage
- File cabinet(s)
- Ergonomic chair(s)

C. NCOIC/intelligence specialists workstation:
- Worksurface with storage
- Bookcase(s)/file cabinet(s)
- Ergonomic chair(s)

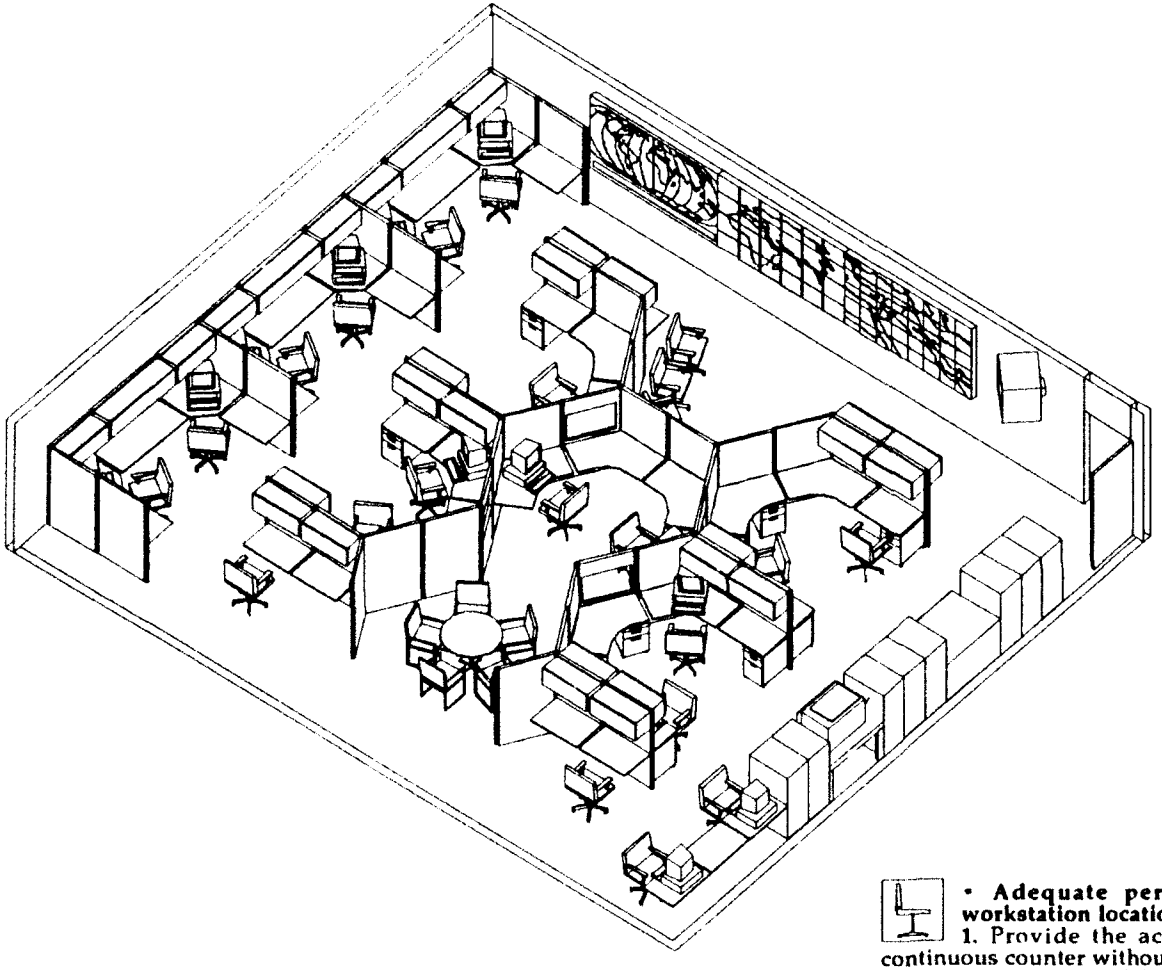
D. Intelligence briefing setup:
- Group work area seating for 8 with classified material container(s) and whiteboard/display surface

E. Full communications support
- Commercial
- Autovon
- Red switch
- Intercom/PA system

F. Group work area for up to 5 people

G. Maps, charts
H. Storage for maps, charts, displays
I. Classified material container(s)
J. Link with applicable data bases
K. News service teleprinters
L. Electrostatic printer
M. Copier(s)
N. TV monitor
O. Cryptographic equipment
P. Microfilm reader
Q. Microcomputer w/printer
R. World clocks

guidance/facility component systems



• Workstation component and seating adjustability for effective ergonomic interaction:

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2. Machine and computer keyboard surfaces are especially important in terms of adjustability -- height, slope, and angle. Video display terminals must be placed at the proper viewing height and angle, along with being adjustable for individual operator needs. Worksurfaces must be located at the proper height for the specified task and be adjustable to suit individual occupant requirements. Suggested surface heights include:

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1. Divider partitions between workstations should be 60 inches high (+/-4 inches) to provide visual privacy while occupants are seated and yet not be confining.

2. A number of divider partitions between workstations should be able to be opened or closed as required to allow for either direct personnel interaction when open or for visual privacy when closed. These convertible partitions are especially relevant for hexagonal workstation configurations since each module has party partitions with several adjacent modules.

• Adequate personnel workstation area and appropriate workstation locations:

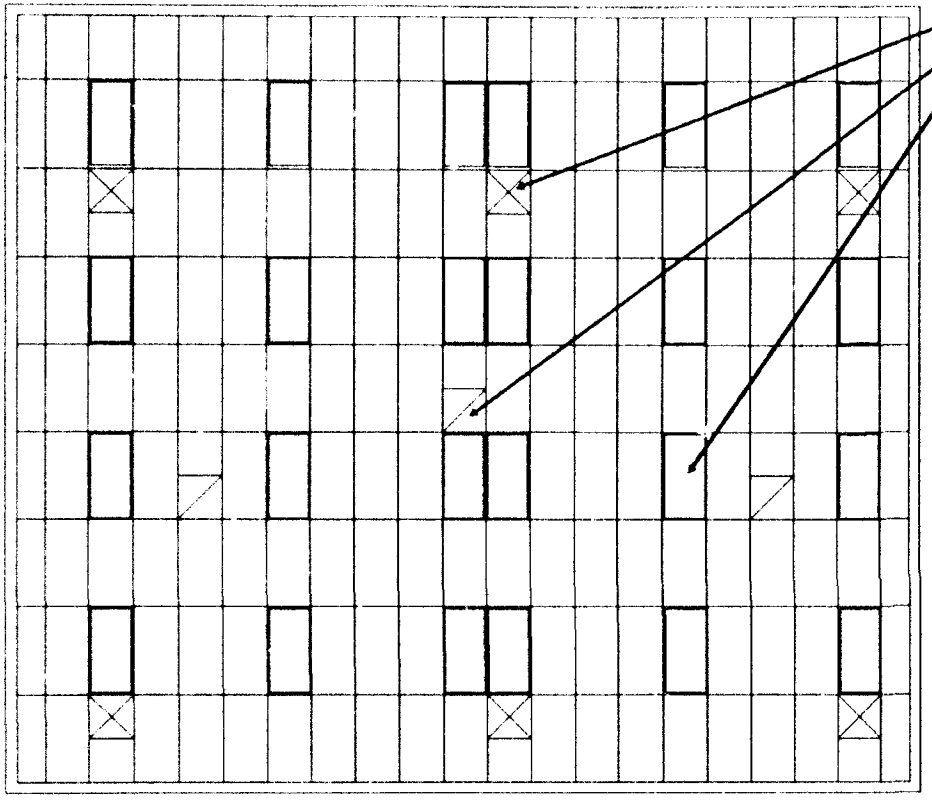
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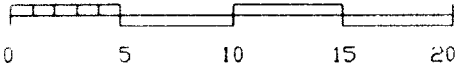
a. maximum amount of desk-type worksurface area available.
b. maximum choice of where AO and equipment can be located and/or co-located, especially when additional AOs are required to augment the assigned personnel for short time periods.

2. Provide the AO system furniture workstations using a standard 36" module throughout. This allows for:

a. easy rearrangement of all components since they will all always be compatible with each other.
b. easy removal of individual desk unit components to accommodate floor-mounted equipment, and then the possible replacement of desk units when the equipment is eventually developed as desktop models.

guidance/facility component systems





REFLECTED CEILING PLAN



• **Optima. acoustic conditions during high a:tivity periods:**
1. In order to provide the best working environment within operations spaces that can accommodate up to 30 or 40 persons at one time, it is suggested that the ceiling surface and available wall surface, where practical, be treated with sound-absorbing material. This treatment will allow for the maximum control of within-room noise levels.



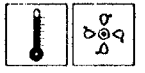
• **Minimize reflected glare on VDT screens:**
1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.



• **Optimal building mechanical system for equipment protection:**
1. An independent air distribution system for electronic equipment spaces is needed.
2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.
3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall be used in electronic equipment cabinets.



• **Enable easy ceiling light fixture changes:**
1. It is intended that there will be periodic changes in the location of personnel workstations. The ceiling fluorescent light fixtures must be installed in a manner to allow for any fixture unit to be moved to an adjacent ceiling grid module in any direction.



• **HVAC mechanical system to adequately accommodate electronic-generated heat loads:**
1. Heat dissipation by computers, radios, and other electronic equipment is relatively constant; therefore, cooling is required year-round. The room sensible-heat ratio is near unity because heat generated by the computer system is all sensible.
2. The number of required air changes per hour should be 10 to 20 because of the equipment's high heat generation.
3. Humidity control is required year-round to maintain necessary conditions. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components.

Policy/SOP

When an emergency or situation reaches a certain level determined by the command center policy, the appropriate authority, typically the director of command center operations, shall authorize the activation of a Crisis Action Team (CAT). The composition of the CAT will vary due to the type, location, and severity of the crisis; however, the CAT may be expected to include representation from any or all of the following areas:

Operations
Intelligence
Transportation
Logistics
Weather
Communications
Automated data processing

The CAT is manned continually by at least two shifts during contingency operations. The CAT director and deputy director are responsible for supervision of the team. Supervision is generally at the 05-06 level.

NOTE:

It should be re-emphasized that the size and composition of the CAT may, and most probably will, differ given the nature of the crisis. The prime concern is to provide a team with the appropriate expertise to manage the situation. Team members may include representatives from areas previously mentioned, as well as other government agencies, as required.

C11
BATTLE STAFF SUPPORT CENTER/CAT

function

For the single-focus collection and aggregation of the necessary information for the planning and scheduling of U.S. forces operations by the Senior Battle Staff during a crisis situation (or a training exercise). Specific operations include: (1) course of action (COA) development, (2) force/resource (F/R) allocation and movement scheduling, (3) logistic and movement resource planning, (4) response options, and (5) feasibility testing in response to warning and threat assessments. (This space can also be for the day-to-day functions of many of the Operations Directorate (J-3) personnel. This continuing use of the space will ensure that the systems and building components will be in operational condition when the CAT assembles periodically.)

Space Subfunctions:

Situation monitoring for the collection of information about a crisis event.
1a. Receive, maintain, integrate, and display data from external systems.
b. Monitor status of crisis event actions.

Force and resource status monitoring.
2a. Monitor, determine, and display the status of readiness of all U.S. forces and resources (including active and reserve elements) and non-U.S. F/R worldwide (including nuclear force status and weapons).
b. Identify and display unit, resources, facilities, communications, and weapons system characteristics and capabilities, planning factors, and performance data.

Situation assessment of the crisis event.
3a. Assess U.S. F/R status relative to non-U.S. F/R status.
h. Develop combined operations/intelligence situation assessment and briefing.

Operations planning and scheduling to develop COA.
4a. Formulate operations objectives and schedule resource utilization
d. Develop and evaluate potential courses of action (COA's) including the definition of COAs and operations for situations that may require the use of U.S. military forces.
g. Perform plan analysis; determine COA/OPLAN force logistics and transportation availability and feasibility.
m. Present plans to decision makers.

Order and mission instruction preparation and dissemination.
6a. Prepare, coordinate and disseminate alert, warning, operations, and mission orders, instructions, and supporting plans; transmit directives.

function

Force employment monitoring as the collection of information concerning the conduct of U.S. and allied military missions
8a. Monitor and display U.S. military operations and mission results; receive, correlate, and maintain mission operations information.
b. Monitor the deployment of forces and material and shipment status.
c. Provide real-time crisis management information to include force movement and logistic data.
l. Compare operations reports with operational objectives and events to determine effectiveness and identify shortfalls.

Hostilities termination and negotiation with enemy representatives.
9a. Assess termination options, conditions, and proposals.
f. Support negotiations.
g. Brief NCA, CINCs, commanders on plan execution/termination, progress and results.
h. Prepare, coordinate, and disseminate operations termination orders.

operations

1. Provide critical information to appropriate levels within a command center from a single staff activity during contingency operations.
2. Provide highly knowledgeable and experienced personnel to make up the Crisis Action Team.
3. Provide coordination of a command center's wartime or contingency mission.
4. Provide communication links with other command centers; maintain required connectivity.
5. Provide for continual monitoring of events within the crisis area.
6. Provide analysis of information from the crisis area.
7. Provide briefings as required.

Staff functions and responsibilities for the operation of this space	Primary responsibility for	Receives input from	Provides input to	Performs at
Personnel		●	●	
Intelligence		●	●	●
Operations	●	●	●	●
Logistics		●	●	●
Plans		●	●	●
Comm.-Electronics		●	●	●

Staff Participation:

Review of the subfunctions and operations associated with this space suggests this mix of functional staff participation. Note that these are generic allocations of staff participation to generically stated subfunctions and operations; they should only be used as initial concept development factors.

activities

1. Monitor crisis situation.
2. Coordinate command center staff activities.
3. Receive/analyze information.
4. Display/distribute information.
5. Access WIN and other required information databases.
6. Maintain communications log.
7. Manage crisis communications processing.
8. Manage all classified information.
9. Maintain secure environment for BSSC/CAT
10. Brief others as required.

personnel

- CAT director (team chief) (one per shift)
- CAT deputy director (one per shift)
- Other personnel (7-36), as required by crisis situation

equipment:

- CAT director workstation:
  - Worksurface with file storage
  - Shelving for references
  - Computer/printer table
  - Ergonomic chair
- CAT deputy director workstation:
  - Worksurface with file storage
  - Shelving for references
  - Computer/printer table
  - Ergonomic chair
- CAT member workstation:
  - (These should be flexible modules that are easily modified depending upon the composition of the CAT and the size of the individual cells (see Guidance).
  - Worksurface with file storage
  - Shelving for references
  - Computer surface with adjustable keyboard support
  - Ergonomic chair
- Coordination table with chairs
- TV system/intercom
- TV monitors
- Red/black phones
- Copiers
- WIN terminals
- AOBC
- AMPS
- Facsimile machines
- Briefing display system
- Lectern with display controls
- Maps, charts, displays, world clocks

requirements	criteria	commentary
1. Enough space to accommodate the equipment and furniture associated with the Battle Staff Support Center/Crisis Action Team.	1. Provide space for the monitoring of information systems, terminals, wire services, communications systems, and other equipment, and for operations personnel and supervisors as required by the command center. Space required for the BSSC/CAT will typically be in the 2000 to 2500 sq. ft. range, depending upon the amount of supporting equipment required by the individual command center.	1.  See Furnishings section in CCDH Volume 3 (page 7-2)
2. A secure environment for the monitoring of sensitive/critical information during crisis and non-crisis situations.	2. The BSSC/CAT area shall be located within the facility so that discussion and presentation of sensitive material in the space cannot be compromised. The access to the space must be controlled so that no one may enter without proper clearance. All appropriate equipment in the space must be TEMPEST certified.	2.  See TEMPEST section of the Security Systems in CCDH Volume 3 (page 7-33).
3. Interior finishes suitable for durability, maintenance, and room function.	3. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material	3.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43)
4. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	4. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise (NC) should be between NC 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	4.  See Acoustical Quality section in CCDH Volume 3 (page 7-51)
5. Comfort features for the occupant such as chair and furniture systems comfort.	5. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	5.  See Seating section in CCDH Volume 3 (page 7-5)
6. Adequate lighting.	6. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	6.  See Interior Lighting in CCDH Volume 3 (page 7-55)
7. Adequate climate control.	7. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate	7.  See HVAC section in CCDH Volume 3 (page 7-65)
8. Accessible power outlets.	8. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall. Provide a raised floor system that allows for easy access to power connections away from the walls.	8. See Electrical Power Systems in CCDH Volume 3 (page 7-70)
9. Fire protection/life safety.	9. Fire suppression systems Automatic Halon 1301, total flooding underfloor system Automatic wet-pipe or pre-action sprinkler system Automatic detection/alarm system for Halon underfloor system	9.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79)

guidance/mission support systems for communication, information processing and briefing and display

• **Minimize numbers of handsets required:**
1. Use red/black interface phones to eliminate the need for multiple handsets.
2. Provide phone handsets with user-friendly single/multiple channel control buttons and with a "message window" that indicates the classification level of the call connection.

• **Adequate communication switching capacity:**
1. The internal and external communication connectivity needs to be optimal during peak crisis periods. Lead team personnel should have state-of-the-art console access.

• **Adequate numbers and quality of the secure/nonsecure telephone units:**
1. Calls to the telephones of key local and distant individuals are established within 10 seconds or less.
2. Voice clarity over all communication paths is equivalent to STU-111 clarity or better.
3. Provide "precedence" capability to assure the most important C3 messages get through first.

• **Adequate numbers and quality of computer terminals:**
1. Necessary types of information (e.g.,messages, maps, TV news) can be sent and received.
2. Undetected data errors are negligible.
3. A computer file that is needed quickly (e.g., a photo) can be delivered electronically within one minute to destinations inside the command center and within 10 minutes to remote destinations.

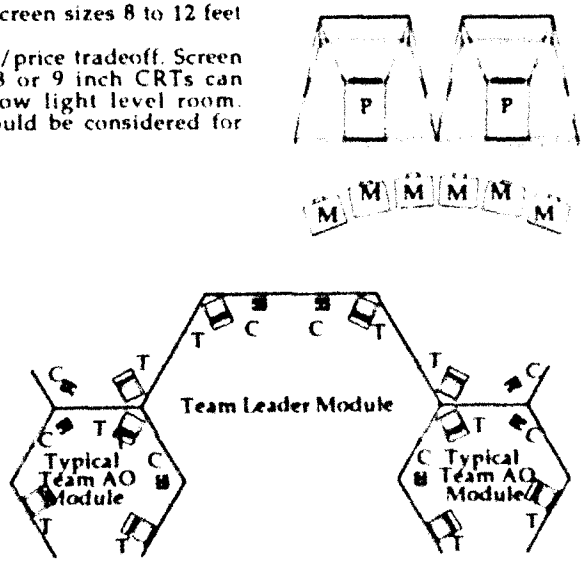
• **Adequate size and quality of LSD images based on distance to primary viewers:**
1. Up to four large screen displays with screen sizes 8 to 12 feet wide.
2. CRT LSD projectors offer highest performance/price tradeoff. Screen sizes from 8 to 10 feet in width employing 8 or 9 inch CRTs can provide adequate displays in a medium-to-low light level room. Projectors employing light-valve technology should be considered for display widths of 10 to 12 feet.

Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.
4. Access to multi-dimensional message service, including electronic mail and file transfers.
5. Access to internal and external facsimile connections that have multi-level-security.

C = communications handset

• **Provide optimal LAN connectivity between the command watch teams:**
1. Structure the LAN topology as "communities -of-interest" group LANs (e.g., CAT space, LCC space, Intel Center space that all have common interface during a crisis event).
2. Limit LAN briefing area applications to those that support command decision-making (e.g., JVIDS, mapping, message handling, database management).

• **Convenient local control of LSD images:**
1. Individual keypad or touchscreen local controller to simplify image selection.
2. Local selection of images may be by controller located on podium., however an alternative method of image selection is advisable when briefers do not wish to control images.
3. Requested images should be displayed in acceptable real time of typically 2 to 5 seconds.



Briefing and Display Subsystem Requirements:
1. Large-screen projection units, either rear-screen units in an adjacent room or self-contained units within the space.
2. Additional TV monitors as required for supplemental displays (CNN, JVIDS, etc.)
3. Audio amplification system with interconnection to other watch and briefing spaces.
4. Display control console, internal or in an adjacent space for local selection of display images.
5. Microphones and speakers with local volume control.
6. Large flat-panel alphanumeric displays, employing plasma technology, to be use to provide general message information.

M = LSD monitor

P = rear screen projector with mirror

Information Processing Subsystem Requirements:
1. Access to a multi-dimensional information processing system that includes:
a. automated message handling system (AMHS)
b. multi-media management and storage system
c. text archival/retrieval system
d. mapping system
e. multi-level security (MLS) gateways
f. distributed processing and heterogenous platform connectivity
2. Computer terminals, connected to all relevant command watch teams, e.g., CSS, Intel, Ops, Logistics, etc.

T = computer terminal

guidance/facility component systems

• Adequate size and quality of LS monitors based on distance to primary viewers:
1. Three to five multiple large screen displays with image sizes between 30 inches (diagonal) and 67 inches (diagonal). For high-scan rate displays, consideration may be given to using 48 or 67 inch (diagonal) self-contained projectors.
2. Large-screen monitors are available that provide display sizes from 30 inches (diagonal) to 37 inches (diagonal). Monitor selection is dependent upon video source signals to be displayed. Large video monitors are generally limited to 15 to 36 kilohertz horizontal scan rates. Scan converters may be necessary.
3. Individual monitor speakers or a single switchable speaker may be employed for television audio. A third alternative is to route television signals to one display only with audio following video to a dedicated speaker. Adjustment of speaker volume should be accessible at the podium and the conference table.

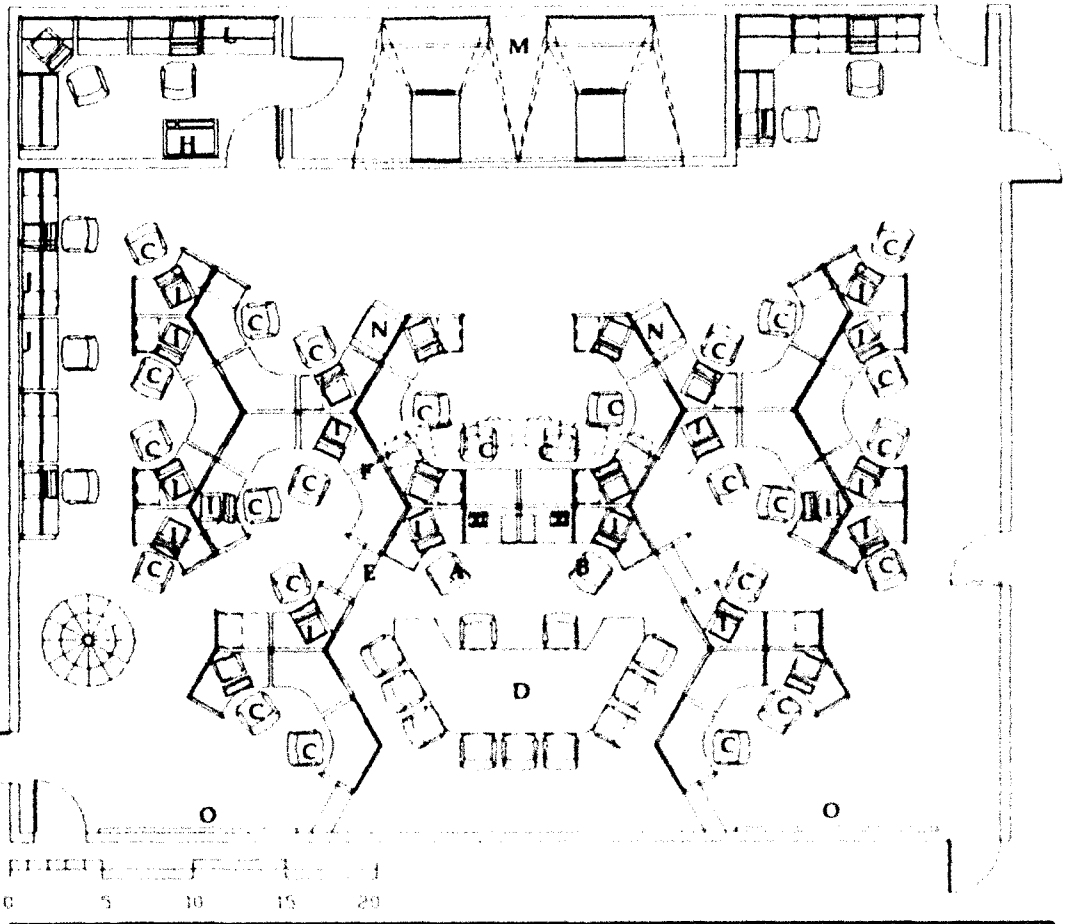
• Space located so the personnel can securely and efficiently interact with others -- especially during crisis events: Typical crisis event activities require that this functional space be located within a SCIF.

• Effective relationship of lead personnel to staff:
1. Locate the senior person(s) at the center of the operational workstations -- with a maximum of 20 to 25 feet from the farthest workstations (and/or display screens).

• Effective conferencing activities for group coordination and planning:
1. Provide conference table and chairs adjacent to lead personnel workstation.
2. Provide whiteboard display surface with mounting ledge (approx. 96" x 48").

• Optimal choice for the rearrangement of personnel workstation modules:
1. To maintain a responsive, efficient work environment, space management should be localized with the first supervisors. Local planning and management are needed to retain equitable space allocation, to maintain previously established standards, and to respond efficiently to changing situations.

• Optimum interoperability of the LAN:
1. In order to take advantage of the IPS currently available, the commands' LAN system will require a UNIX-based platform, and should be compliant with GOSIP, X Window, and Motif standards.
2. AO's connected to the command LAN require terminals similar to UNIX-based integrated workstations.
3. In order to support operations, the LAN requires several laser printers with a minimum of 2 MB of random access memory (RAM).



Equipment List

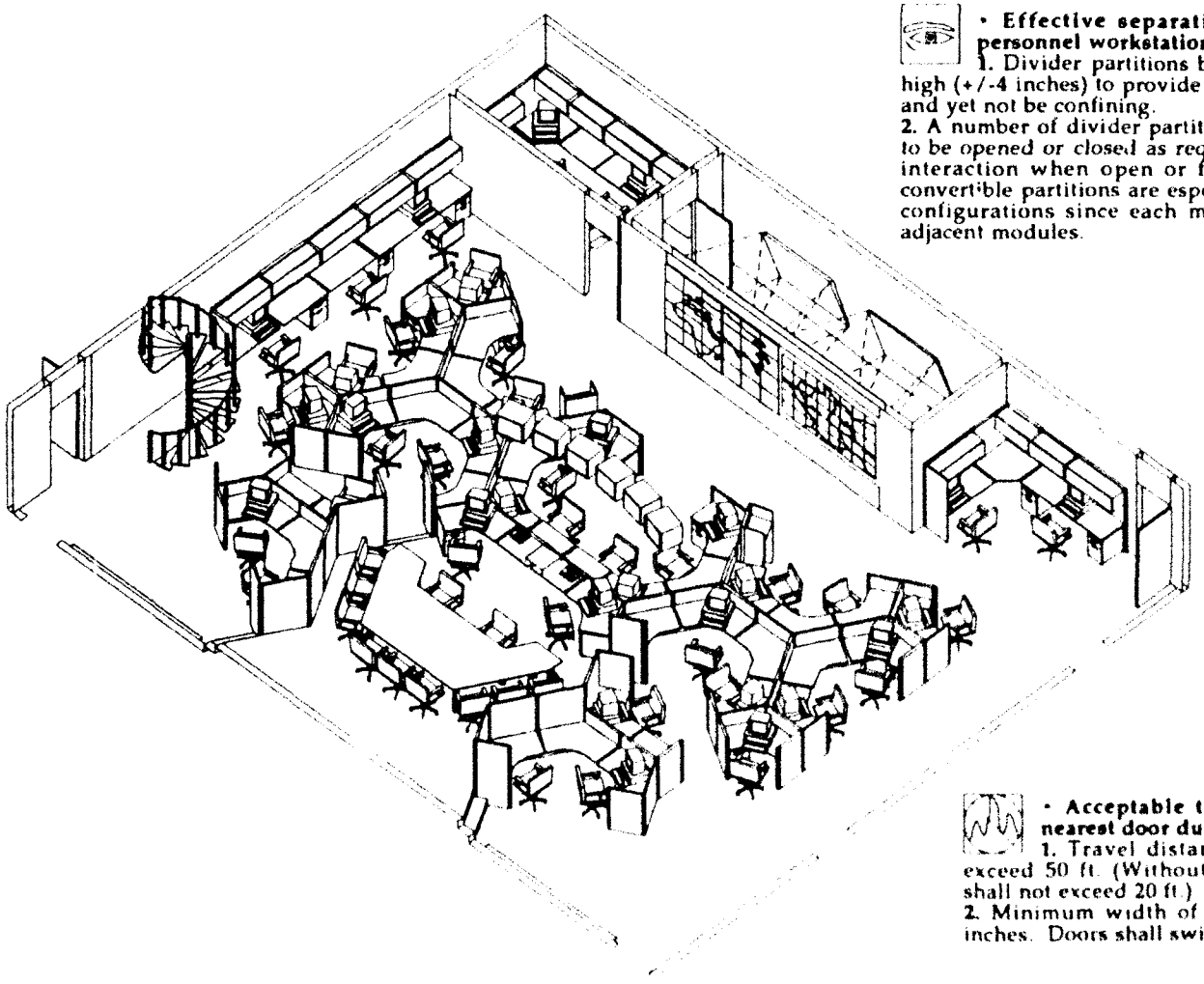
A. CAT director workstation:
- Worksurface with storage
- Bookshelve(s)/file cabinet(s)
- Computer/printer table
- Ergonomic chair(s)

B. CAT deputy director workstation:
- Worksurface with storage
- Bookshelve(s)/file cabinet(s)
- Computer/printer table
- Ergonomic chair(s)

C. CAT member workstation:
- (These should be flexible modules that are easily
- modified depending upon the composition of the CAT and the size of the individual cells. (see guidance)
- Worksurface with storage
- Bookshelves/file cabinet(s)
- Computer surface with adjustable keyboard support
- Ergonomic chair(s)

D. Coordination table
E. TV system/intercom
F. TV monitors
G. Red/black phones
H. Copiers
I. WIN terminals
J. AOBC
K. AMPS
L. FAX machines
M. Briefing display system
N. Lectern with display controls
O. Maps, charts, displays, world clocks

guidance/facility component systems



• Effective separation and/or interconnectivity between personnel workstations:
1. Divider partitions between workstations should be 60 inches high (+/-4 inches) to provide visual privacy while occupants are seated and yet not be confining.
2. A number of divider partitions between workstations should be able to be opened or closed as required to allow for either direct personnel interaction when open or for visual privacy when closed. These convertible partitions are especially relevant for hexagonal workstation configurations since each module has party partitions with several adjacent modules.

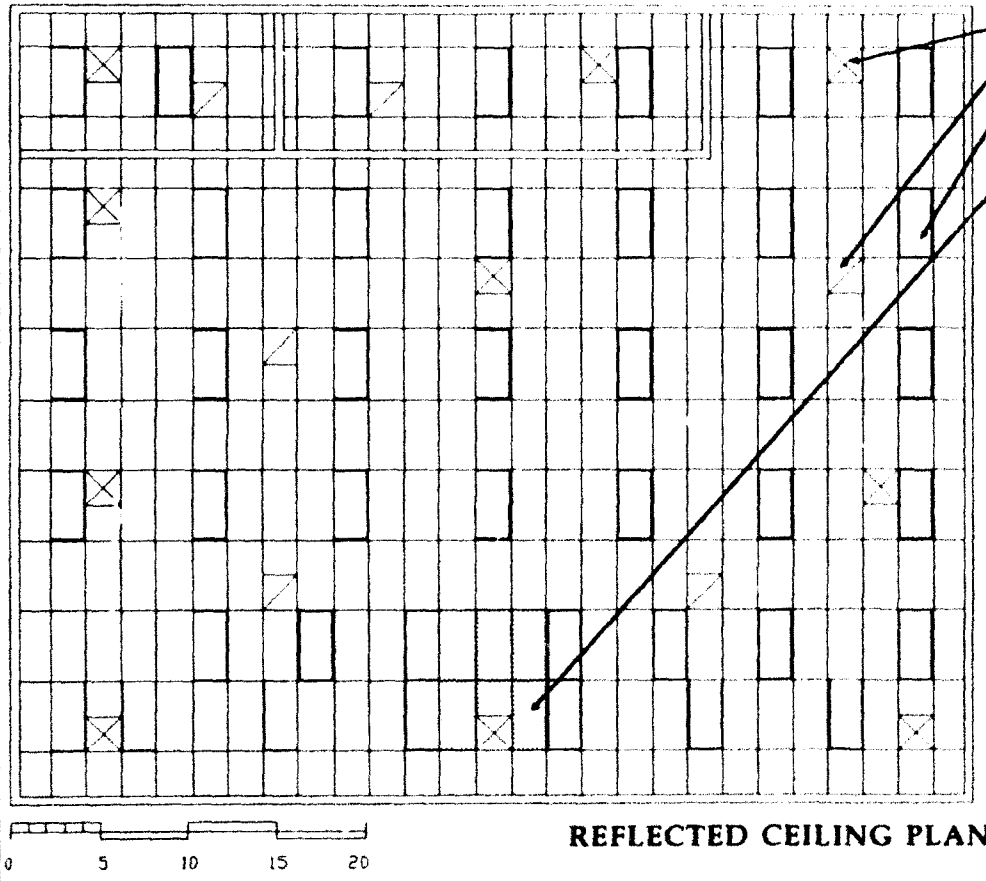
• Workstation component and seating adjustability for effective ergonomic interaction:
1. Seating for virtually all positions, clerical, computer operator, technician, and supervisory, should be of the type that is adjustable to a range of tasks and individual needs. Adjustments should include seat height, backrest height, seat pan tilt, and backrest angle.
2. Machine and computer keyboard surfaces are especially important in terms of adjustability -- height, slope, and angle. Video display terminals must be placed at the proper viewing height and angle, along with being adjustable for individual operator needs. Worksurfaces must be located at the proper height for the specified task and be adjustable to suit individual occupant requirements. Suggested surface heights include
a. working/writing surface 26"-31"
b. machine interaction surface 24"-27"
c. computer keyboard surface 24"-30"

• Acceptable travel distance within the space to the nearest door during a fire:
1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)
2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.

• Adequate personnel workstation area and appropriate workstation locations:
1. Provide the action officer (AO) workstation furniture as a continuous counter without any kneehole constraints. This allows for:
a. maximum amount of desk-type worksurface area available.
b. maximum choice of where AO and equipment can be located and/or co-located, especially when additional AOs are required to augment the assigned personnel for short time periods.
2. Provide the AO system furniture workstations using a standard 36" module throughout. This allows for:
a. easy rearrangement of all components since they will all always be compatible with each other.
b. easy removal of individual desk unit components to accommodate floor- mounted equipment, and then the possible replacement of desk units when the equipment is eventually developed as desktop models.

• Acceptable travel distance to the nearest building exit during a fire:
1. Travel distance to the nearest exit shall not exceed 300 ft (Without a sprinkler system the travel distance shall not exceed 200 ft.)

guidance/facility component systems



REFLECTED CEILING PLAN

• Optimal acoustic conditions during high activity periods:
1. In order to provide the best working environment within operations spaces that can accommodate up to 30 or 40 persons at one time, it is suggested that the ceiling surface and available wall surface, where practical, be treated with sound-absorbing material. This treatment will allow for the maximum control of within-room noise levels.

• Room acoustic conditions determined by audio system designs:
1. For meeting-type rooms a successful microphone/speaker system depends upon the surface treatment in the room itself. Both the floor and walls should be covered with sound-absorbing materials. The ceiling surface, however, should be reflective over the conference table area and over the observer seating areas.

• Ability to view projected graphics while simultaneously performing normal work tasks:
1. Ceiling ambient light fixtures (usually fluorescent) in rooms having large projection screens should be in "bank-switched" rows, with the row directly in front of the screens having non-reflective louvers so that no ambient light will wash out the projected image.
2. Flexible task light fixtures should be provided at all individual office-type workstations where AO continue normal work tasks during presentations.

• HVAC mechanical system to adequately accommodate electronic-generated heat loads:
1. Heat dissipation by computers, radios, and other electronic equipment is relatively constant; therefore, cooling is required year-round. The room sensible-heat ratio is near unity because heat generated by the computer system is all sensible.
2. The number of required air changes per hour should be 10 to 20 because of the equipment's high heat generation.
3. Humidity control is required year-round to maintain necessary conditions. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components.

• Minimize reflected glare on VDT screens:
1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

Policy/SOP

Command center policy will indicate the clearance level of personnel who may be authorized access to this area. The access, however, must be secured and controlled due to the nature of information involved. Standard command center operating procedure *will normally require that this area* be kept in a state of readiness similar to that of other areas that function during crisis operations.

C12
CAT BRIEFING ROOM

function

For the presentation of the situation assessments and operations plans under development by the Crisis Action Team. Information to be displayed and/or briefed includes course of action (COA) development, force/resource (F/R) allocation, and movement scheduling, logistic and movement resource planning, response options, and plans development.

Space Subfunctions:

2a. Monitor, determine, and display the status of readiness of all U.S. forces and resources (including active and reserve elements) and non-U.S. F/R worldwide (including nuclear force status and weapons).
b. Identify and display unit, resources, facilities, communications, and weapons system characteristics and capabilities, planning factors, and performance data.
c. Identify critical logistic resources.
d. Identify the location and status of airlift and sealift assets.
e. Assess force operational readiness capability and availability; identify the deployability status of designated forces.

operations

1. Provide display of operational and contingency information relating to a crisis situation.
2. Provide monitoring of real-time information during crisis or contingency operations.
3. Provide dissemination of crisis information.
4. Provide secure and non-secure communications and information links with other crisis action organizations.
5. Provide ad hoc informational briefings to principal military and civilian authorities who are not directly involved in the contingency operation.

Staff functions and responsibilities for the operation of this space	Primary responsibility for	Receives input from	Provides input to	Performs at
Personnel				
Intelligence		●	●	
Operations	●		●	●
Logistics		●	●	●
Plans				
Comm.-Electronics		●	●	●

Staff Participation:

Review of the subfunctions and operations associated with this space suggests this mix of functional staff participation. Note that these are generic allocations of staff participation to generically stated subfunctions and operations, they should only be used as initial concept development factors.

activities

1. Receive/monitor crisis information.
2. Compile/integrate crisis information.
3. Disseminate crisis information.
4. Prepare and deliver informational briefings.
5. Display crisis information.
6. Communicate with other crisis agencies.
7. Record communications and proceedings as required.

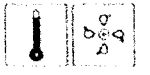
personnel

- While there are no personnel who are stationed within the room, the room will accommodate ad hoc briefings for small groups (2-10) of both involved and non-involved personnel.

equipment

- Wall panels and conventional displays for maps, charts, etc.
- Weather displays
- DEFCON status board
- Red/black telephones
- Secure intercom
- NIDS terminals
- DISIDS monitors
- TV/Video monitors
- Visual-voice recorders
- Other applicable information database displays
- Lectern with display controls
- Rear-screen projection

notes

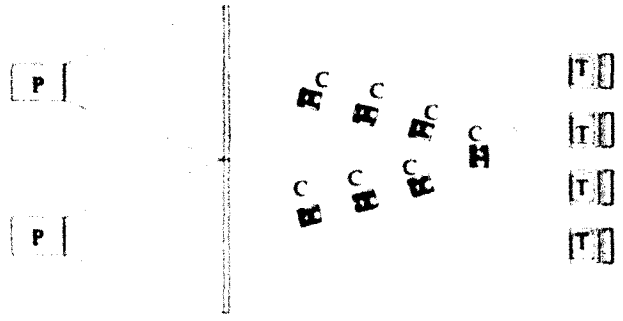
requirements	criteria	commentary
1. Enough space for briefing personnel and equipment.	1. The CAT Briefing Area should be large enough to accommodate groups of 10 to 15 people for informal situation briefings. The space necessary for this purpose may range from 700 to 900 sq. ft., depending upon the number and type of information media present within the space.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. A secure environment for the monitoring of sensitive/critical information during crisis and non-crisis situations.	2. The CAT Briefing Area shall be located within the facility so that discussion and presentation of sensitive material in the space cannot be compromised. The access to the space must be controlled so no one may enter without proper clearance. All appropriate equipment in the space must be TEMPEST certified.	2.  See TEMPEST section of the Security Systems in CCDH Volume 3 (page 7-33).
3. Interior finishes suitable for durability, maintenance, and room function.	3. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	3.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
4. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	4. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise (NC) should be between NC 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	4.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
5. Comfort features for the occupant such as chair and furniture systems comfort.	5. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	5.  See Seating section in CCDH Volume 3 (page 7-5).
6. Adequate lighting.	6. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	6.  See Interior Lighting in CCDH Volume 3 (page 7-55).
7. Adequate climate control.	7. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	7.  See HVAC section in CCDH Volume 3 (page 7-65).
8. Accessible power outlets.	8. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall. Provide a raised floor system that allows for easy access to power connections away from the walls	8. See Electrical Power Systems in CCDH Volume 3 (page 7-70)
9. Fire protection/life safety.	9. Fire suppression systems. Automatic Halon 1301, total flooding underfloor system Automatic wet-pipe or pre-action sprinkler system Automatic detection/alarm system for Halon underfloor system	9.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79)

guidance/mission support systems for communication, information processing, and briefing and display

• Adequate size and quality of LSD images based on distance to primary viewers:
1. Up to three large screen displays, with screen sizes 6 to 8 feet wide.
2. CRT LSD projectors offer highest performance/price tradeoff. For 6 to 8 foot wide displays, projectors employing 7 or 8 inch CRTs will provide adequate displays in a medium-to-low light level room. If rear-screen projection is not possible, consider self-contained projection units.)
3. Digital convergence projectors should be selected.

Briefing and Display Subsystem Requirements:
1. Large-screen projection units, either rear-screen units in an adjacent room or self-contained units within the space.
2. Audio amplification system with interconnection to other watch and briefing spaces.
3. Display control console, internal or in an adjacent space for local selection of display images.
4. Microphones and speakers with local volume control.

P=rear screen projector



• Provide optimal LAN connectivity between the command watch teams:
1. Structure the LAN topology as "communities -of-interest" group LANs (e.g., CAT space, LCC space, Intel Center space that all have common interface during a crisis event).
2. Limit LAN briefing area applications to those that support command decision-making (e.g., JVIDS, mapping, message handling, database management).

Information Processing Subsystem Requirements:
1. Access to a multi-dimensional information processing system that includes:
a. automated message handling system (AMHS)
b. multi-media management and storage system
c. text archival/retrieval system
d. mapping system
e. multi-level security (MLS) gateways
f. distributed processing and heterogenous platform connectivity
2. Computer terminals, connected to all relevant command watch teams, e.g., CSS, Intel, Ops, Logistics, etc

T = computer terminal

• Convenient local control of LSD images:
1. Individual keypad or touchscreen local controller to simplify image selection.
2. Local selection of images may be by controller located on podium, however an alternative method of image selection is advisable when briefers do not wish to control images.
3. Requested images should be displayed in acceptable real time of typically 2 to 5 seconds.

• Adequate audio speaker system for briefings:
1. Multiple 6 or 8 inch ceiling speakers should be placed throughout the room to assure all personnel are within hearing range without excessive volume.
2. In addition to a master volume control, individual volume controls are recommended at the podium and at a location convenient to the conference table.

• Minimize numbers of handsets required
1. Use red/black interface phones to eliminate the need for multiple handsets.
2. Provide phone handsets with user-friendly single/multiple channel control buttons and with a "message window" that indicates the classification level of the call connection.

• Adequate facsimile capability
1. Provide both non-secure and secure facsimile machines with at least one spare machine available at each level.
2. Tie in the FAX capability with the LAN system to take advantage of LAN scanner, printers, etc.

Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.
4. Access to multi-dimensional message service, including electronic mail and file transfers.
5. Access to internal and external facsimile connections that have multi-level-security.

C = communications handset

• Optimum interoperability of the LAN
1. In order to take advantage of the IPS currently available, the commands' LAN system will require a UNIX-based platform, and should be compliant with GOSIP, X Window, and Motif standards.
2. AO's connected to the command LAN require terminals similar to UNIX-based integrated workstations.
3. In order to support operations, the LAN requires several laser printers with a minimum of 2 MB of random access memory (RAM).

• Adequate communication switching capacity
1. The internal and external communication connectivity needs to be optimal during peak crisis periods. Lead team personnel should have state-of-the-art console access.

• Adequate numbers and quality of the secure/nonsecure telephone units
1. Calls to the telephones of key local and distant individuals are established within 10 seconds or less.
2. Voice clarity over all communication paths is equivalent to STU-III clarity or better.
3. Provide "precedence" capability to assure the most important C3 messages get through first.

guidance/facility component systems

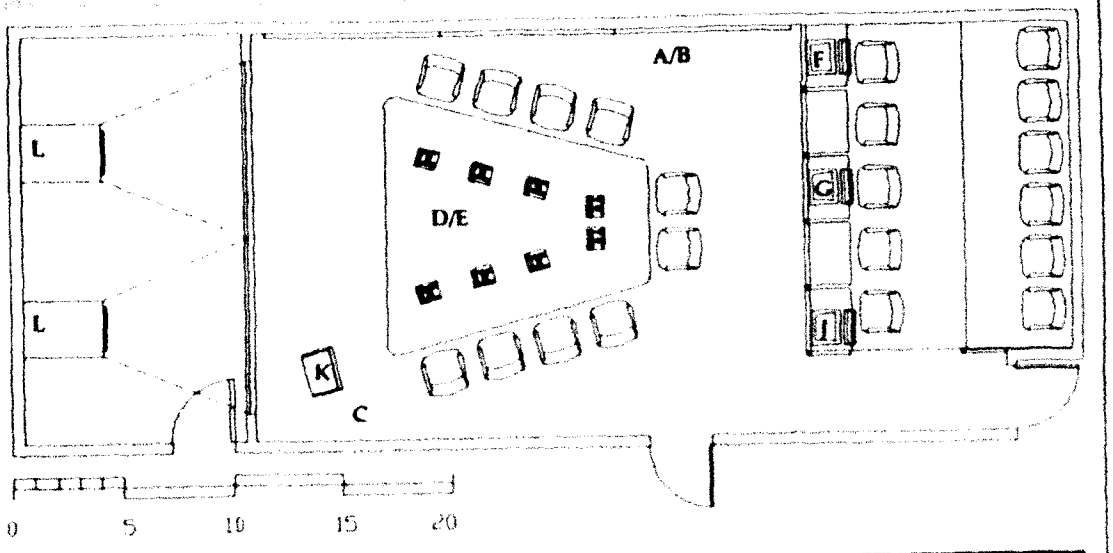
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1. Provide conference table and chairs adjacent to lead personnel workstation.
2. Provide whiteboard display surface with mounting ledge (approx. 96" x 48").

• **Space located so the personnel can securely and efficiently interact with others -- especially during crisis events:**
1. This functional space should be located within the core of a command center. The desired location is adjacent to or near the Crisis Action Team space.
2. Typical crisis event activities require that this functional space be located within a SCIF.

• **Acceptable travel distance within the space to the nearest door during a fire:**
1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)
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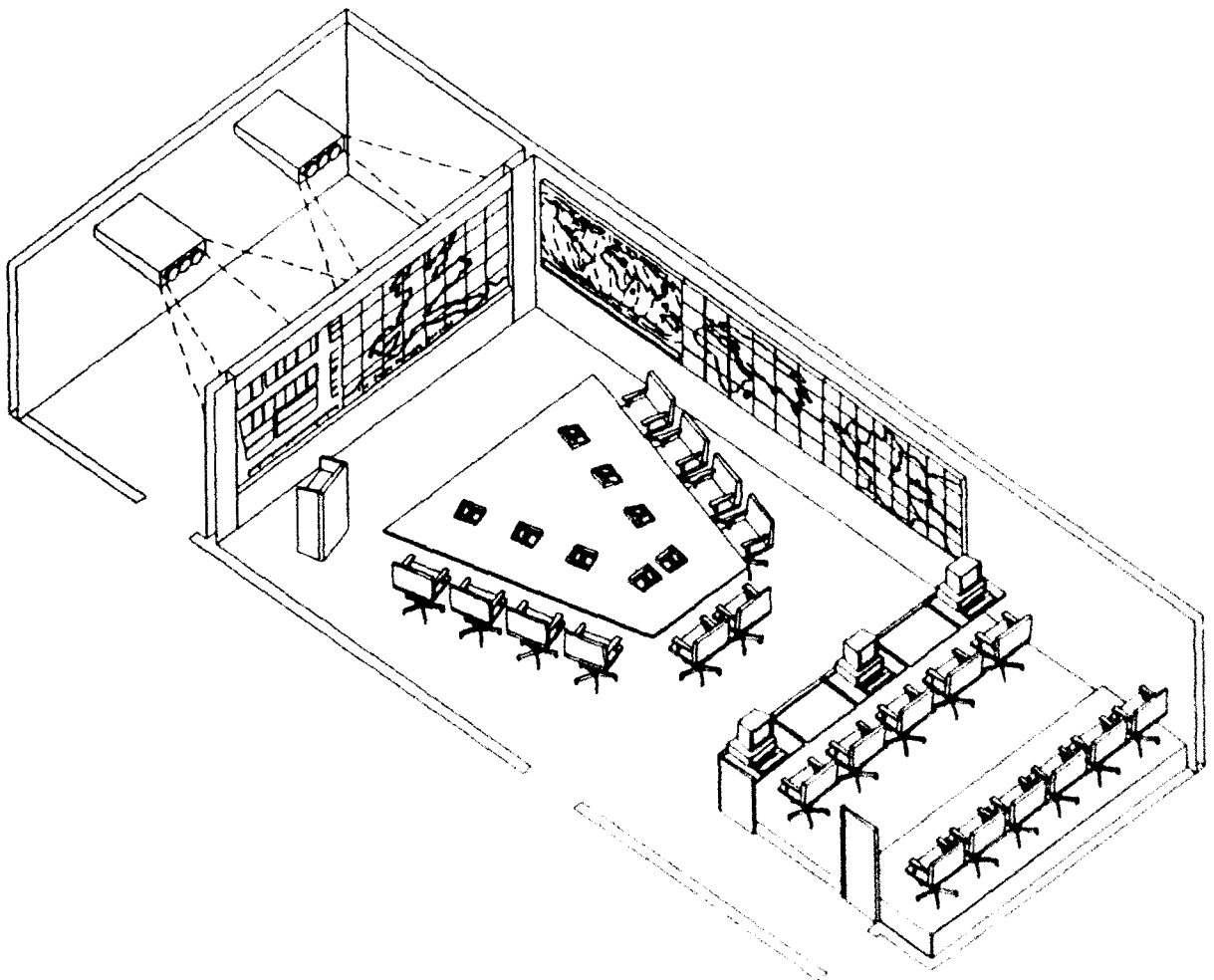
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1. Necessary types of information (e.g., messages, maps, TV news) can be sent and received.
2. Undetected data errors are negligible.
3. A computer file that is needed quickly (e.g., a photo) can be delivered electronically within one minute to destinations inside the command center and within 10 minutes to remote destinations.



Equipment List

A. Wall panels and conventional displays for maps, charts, etc.
B. Weather displays
C. DEFCON status board
D. Red/black telephones
E. Secure intercom
F. NIDS terminals
G. DISIDS monitors
H. TV/video monitors
I. Visual-voice recorders
J. Other applicable information data base displays
K. Lectern with display controls
L. Rear screen projection

guidance/facility component systems



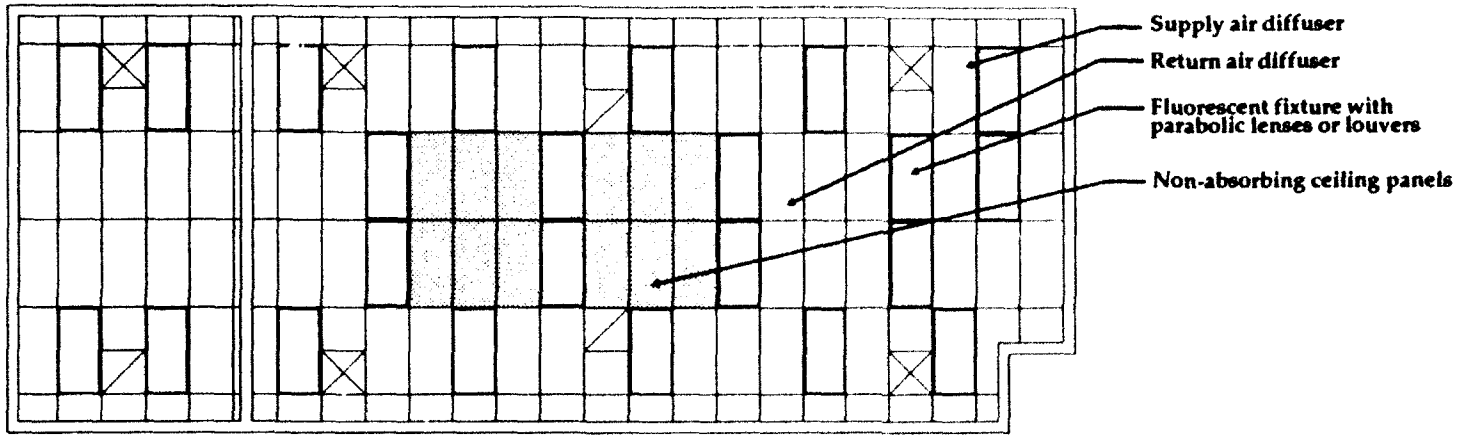
• **Wall treatment for effective graphic displays:**
1. Provide extensive perimeter wall space to allow for the display and review of completed graphic displays. In addition, a 72" x 48" chalkboard/ whiteboard should be periodically provided for the development and display of conceptual ideas. Arranging the personnel workstations in the center of the space makes much of the perimeter wall surface available for the required graphic display and whiteboards.

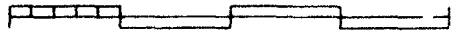
• **Room acoustic conditions determined by audio system designs:**
1. For meeting-type rooms a successful microphone/speaker system depends upon the surface treatment in the room itself. Both the floor and walls should be covered with sound-absorbing materials. The ceiling surface, however, should be reflective over the conference table area and over the observer seating areas

• **Adequate brightness of projected graphics:**
A rear-screen projector with a minimum output of 1000 lumens is recommended for an approximately eight-foot-wide image. Reducing the screen width to approximately six feet permits the use of projectors with a brightness of 600 lumens. WARNING: Large-screen projector images of highly detailed graphics may have limited legibility no matter how bright they are.

• **Coordination of graphic presentations by briefers:**
The briefers' lectern should contain the necessary communication connectivity to control the automated presentations and/or the necessary communication connection to those who do manual presentations. Such controls must be simple and obvious, since the briefers must primarily concentrate on text. (Ambient lighting controls should be on the room walls adjacent to the lectern rather than being on the lectern itself.)

guidance/facility component systems





REFLECTED CEILING PLAN



• **Optimal building mechanical system for equipment protection:**
1. *An independent air distribution system for electronic equipment* spaces is needed.
2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.
3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall be used in electronic equipment cabinets.
4. Duct fire dampers shall be used in ducts that penetrate two-hour fire resistance-rated walls, partitions, shafts.



• **Impact of HVAC system noises on acoustical conditions:**
Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.

Policy/SOP

During non-crisis situations or for day-to-day operations, the Nuclear Planners Group is responsible to the Joint Staff for actions pertaining to SIOP operations and North American defensive operations. During crisis situations, the Nuclear Planning Group serves as the recognized Joint Staff element responsible for SIOP matters.

C13
NUCLEAR PLANNERS GROUP CENTER

function

For the analysis of related information and the development of plans of action in response to nuclear situations. For the direction of nuclear attack warnings, development of civil defense and citizen safety policy, and the support of the SIOP mission.

Space Subfunctions:

2a. Monitor, determine, and display the status of readiness of all U.S. forces and resources (F/R) (including active and reserve elements) and non-U.S. F/R worldwide (including nuclear force status and weapons).
b. Identify and display unit, resources, facilities, communications, and weapons system characteristics and capabilities, planning factors, and performance data.
c. Identify critical logistic resources.
d. Identify the location and status of aircraft and sealift assets.
e. Assess force operational readiness capability and availability; identify the deployability status of designated forces.

3a. Assess U.S. F/R status relative to non-U.S. F/R status.
b. Determine military implications of intelligence indicators and enemy order of battle (EOB).
c. Assess events relative to U.S. policies, treaties, interests, etc. and impacts on U.S. (military) operations.
d. Establish the nature of hostilities and crises and assess their impact.
e. Determine U.S., Allied, and friendly capability to contain the situation.
f. Determine the implications of U.S. involvement.
g. Evaluate changes in the status of the civil sectors.
h. Develop a combined operations/intelligence situation assessment and briefing.
i. Determine a net situation assessment.
j. Support the determination that an attack is in progress and provide an assessment of the nature of the attack.

4a. Formulate operations objectives and schedule resource utilization.
b. Generate and refine F/R requirements and options, movement requirements, resupply and non-unit personnel requirements.
c. Merge, modify, and tailor force lists and force movement requirements to crisis operations.
d. Develop and evaluate potential courses of action (COA) including the definition of COAs and operations for situations that may require the use of U.S. military forces. COA development is normally very time-sensitive and involves the determination of forces, logistics support, personnel, and transportation requirements to support contingencies for which no plans exist.

function

e. Match and select COA/OPLAN force and movement requirements with actual forces and resources, and allocate forces and resources to plans. Includes use of U.S. and/or Allied military forces and material, and host nation support.
f. Determine and allocate F/R to special logistics requirements such as engineering, POL, ammunition, medical, and other critical areas, as applicable.
g. Perform plan analysis; determine COA/OPLAN force logistics and transportation availability and feasibility. Identify logistics, transportation, and personnel shortfalls; assess adequacy of plans to achieve objectives, considering intelligence inputs.
h. Assess projected capabilities to satisfy sustainment requirements for long-range COAs and contingency operations.
m. Present plans to decision-makers.

8a. Monitor and display U.S. military operations and mission results; receive, correlate, and maintain mission operations information.
b. Monitor the deployment of forces and material; monitor shipment status.
c. Provide real-time crisis management information to include force movement and logistic data.
d. Monitor force generation.
e. Monitor the movement of forces from home stations to mobilization stations and the movement of non-deploying material within CONUS.
f. Monitor the reception and onward movement of deploying forces and resources within theaters of operation.
h. Provide reconnaissance information for damage assessment.
i. Provide bomb damage information, weapon strike data; assess U.S., Allied, and enemy operations and strike results.
j. Provide nuclear detonation information.
k. Perform attack, strike, damage, and residual capability assessment; estimate remaining operational capability.
l. Compare operations reports with operational objectives and events to determine effectiveness and identify shortfalls.

9a. Assess termination options conditions, and proposals.
b. Determine implications of termination.
c. Assess feasibility of termination; determine degree to which objectives have been achieved.
d. Define terms of termination.
e. Terminate hostilities and active operations.
f. Support negotiations.

operations

1. Provide support of the SIOP mission.
2. Provide development and maintenance of plans for defensive operations relating to North America.
3. Provide for the planning, targeting, testing, safety, security, allocation, policy delineation, and continuous status reporting of all strategic missiles.
4. Provide for cognizance of U.S. Civil Defense and NORAD provision for attack warning.

Staff functions and responsibilities for the operation of this space	Primary responsibility for:	Receives input from:	Provides input to:	Performs at:
Personnel				
Intelligence		●		
Operations	●	●	●	
Logistics		●		
Plans		●		
Comm.-Electronics		●	●	

notes

NUCLEAR PLANNERS GROUP CENTER ADMINISTRATION AREA:

activities

1. Direct/supervise all NPG elements.
2. Clerical support activities -- typing, filing, storage, etc.
3. Receive visitors.
4. Hold informal briefing sessions or meetings.

Personnel

- 1 NPG Chief
- 1 secretary/receptionist

equipment

- NPG chief workstation:
  - Worksurface with storage
  - File cabinet
  - Ergonomic chair
  - Conference table seating for 6
- Clerical workstation
  - Worksurface with storage
  - Typing surface
  - Typewriter
  - Ergonomic chair
- 2-4 visitor's chairs
- Word processor
- File cabinets
- Copier
- Telephone/intercom
- Storage cabinets

NUCLEAR PLANNERS GROUP CENTER OPERATIONS AREA:

activities

1. Monitor strategic missile status.
2. Maintain comm/data link with all nuclear missile sites.
3. Maintain communications link with all applicable command center elements.
4. Develop/disseminate strategic missile policy.
5. Receive/analyze information.
6. Prepare status reports.
7. Prepare briefings as necessary.

Personnel

- 1 senior sction officer
- 6-10 action officers

equipment

- Sr. action officer workstation:
  - Worksurface with storage
  - File cabinet
  - 2 visitor's chairs
  - Ergonomic chair
- Action officer workstation:
  - Worksurface with storage
  - File cabinet
  - Ergonomic chair
- Full communications support:
  - Autovon
  - Commercial
  - Red switch
  - Intercom
  - PA system
- 1-2 group work areas with seating for 4-6 at each
- Link with all applicable information databases
- Whiteboard/display surface
- Reference material area
- Bookcases/map files
- Storage cabinets
- World clocks
- Microcomputer (NPES)

NUCLEAR PLANNERS GROUP CENTER INTELLIGENCE VAULT:

activities

The intelligence vault area provides a Sensitive Compartmentalized Information Facility (SCIF) for accomplishing activities similar to those listed under the Operations Area heading.

Personnel

- No one is permanently assigned to this area; however, workstations for 4-6 operations personnel should be accommodated within the vault.

equipment

- Action officer workstations:
  - Worksurface with storage
  - File cabinet
  - Ergonomic chair
- Full communications support:
  - Autovon
  - Commercial
  - Red switch
  - Intercom
  - PA system
- Link w/all applicable databases
- Whiteboard/display surface
- Reference material area
- Bookcases/map files
- SIOP safes
- World clocks

NUCLEAR PLANNERS GROUP CENTER NUCLEAR SITUATION ROOM:

activities

1. Receive information.
2. Analyze information.
3. Form decisions and determine policy.
4. Disseminate policy and decisions to appropriate command center elements.

Personnel

- 1-2 briefers
- Up to 20 NPG personnel

equipment

- Conference table with seating for 20
- 1-2 briefing positions with control of lighting, communication, and visual displays
- Rear-screen projection
- Whiteboard/display surface
- Video display terminals
- Full communications support:
  - Red/black phones
  - Intercom
  - PA system
- World clocks

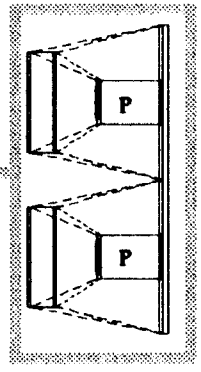
requirements	criteria	commentary
1. Enough space to accommodate the equipment and personnel associated with the Nuclear Planners Group Center function and located within the following areas: Administration Area Operations Area Intelligence Vault Nuclear Situation Room.	1. Provide space for the monitoring and reporting of the status and capability of nuclear strategic missiles and the development of policy regarding safety and defensive measures. This space will typically be arranged into a series of spaces or areas, depending upon the scope of the command center mission. Space required in the individual spaces should be in the range of: Administration Area 300 sq. ft. Operations Area 1300 sq. ft. Intelligence Vault 450 sq. ft. Nuclear Situation Room 800 sq. ft.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. A secure environment for the monitoring of sensitive/critical information during crisis and non-crisis situations.	2. The Nuclear Planners Group Center shall be located within the facility so that discussion and presentation of sensitive material in the space cannot be compromised. The access to the space must be controlled so that no one may enter without proper clearance. All appropriate equipment in the space must be TEMPEST certified.	2.  See TEMPEST section of the Security Systems in CCDH Volume 3 (page 7-33).
3. Interior finishes suitable for durability, maintenance, and room function.	3. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	3.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
4. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	4. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise (NC) should be between NC 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	4.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
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guidance/mission support systems for communication, information processing, and briefing display

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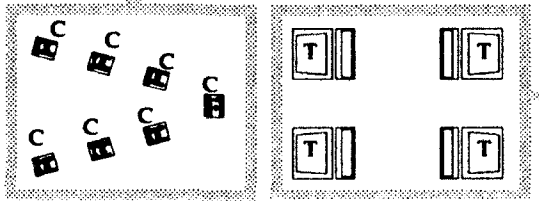
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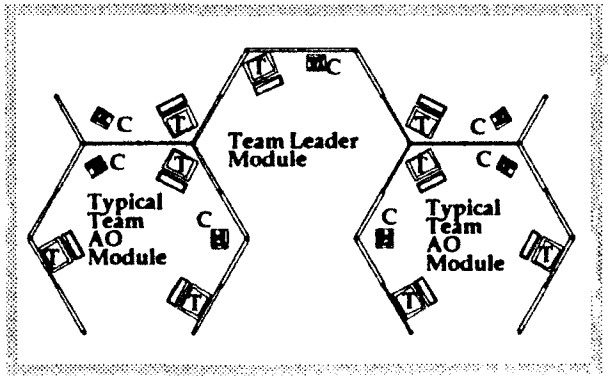
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guidance/facility component systems

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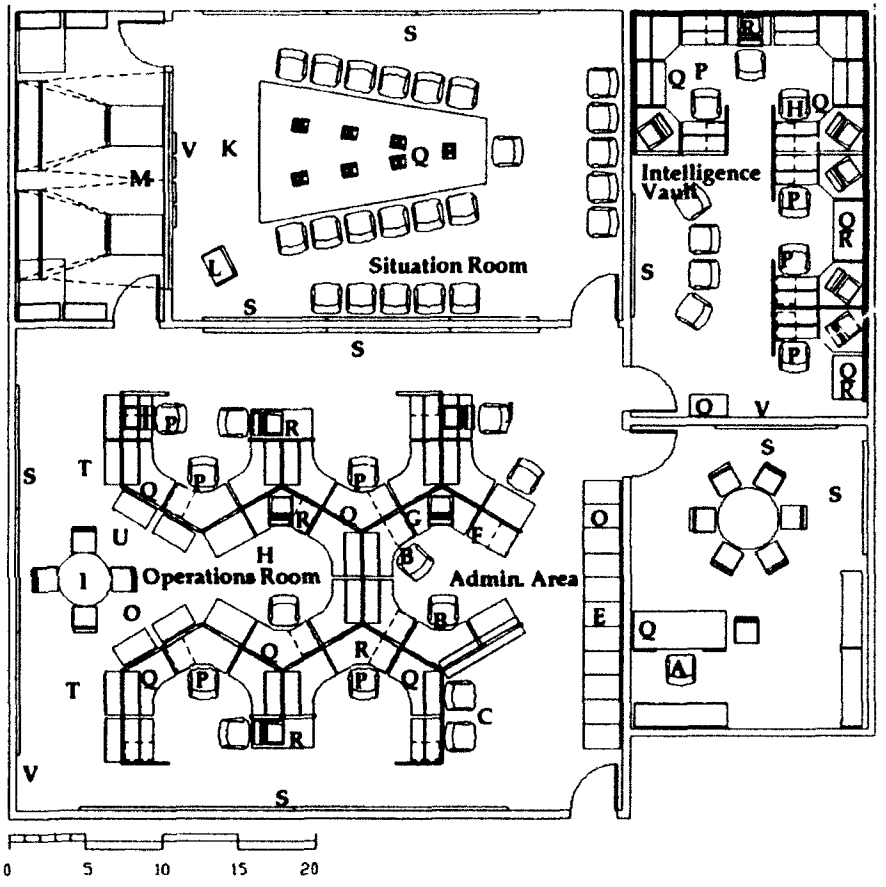
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• Acceptable travel distance to the nearest building exit during a fire:
1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)

• Optimal choice for the rearrangement of personnel workstation modules:
1. To maintain a responsive, efficient work environment, space management should be localized with the first supervisors. Local planning and management are needed to retain equitable space allocation, to maintain previously established standards, and to respond efficiently to changing situations.

• Effective conferencing activities for group coordination and planning:
1. Provide conference table and chairs adjacent to lead personnel workstation.
2. Provide whiteboard display surface with mounting ledge (approx. 96" x 48").

• Optimal individual choice for the extent and location of the componentry in personnel workstation modules:
1. Provide personnel workstations using system furniture componentry with a single modular dimension of 36". This allows for:
a. easy rearrangement of all components since they will always be compatible with each other.
b. easy removal of individual desk unit components to accommodate floor-mounted equipment, and then the possible replacement of desk units when the equipment is eventually developed as desktop models. Personnel workstations using system furniture 36" components can be configured as either rectangular or hexagonal modules. The hexagonal modules are recommended for this space.



Equipment List

A. NPG chief workstation:
- Worksurface with storage
- File cabinet(s)
- Ergonomic chair(s)
- Conference table
- Seating for 6

B. Clerical workstation:
- Worksurface with storage
- Typing surface
- Typewriter
- Ergonomic chair(s)

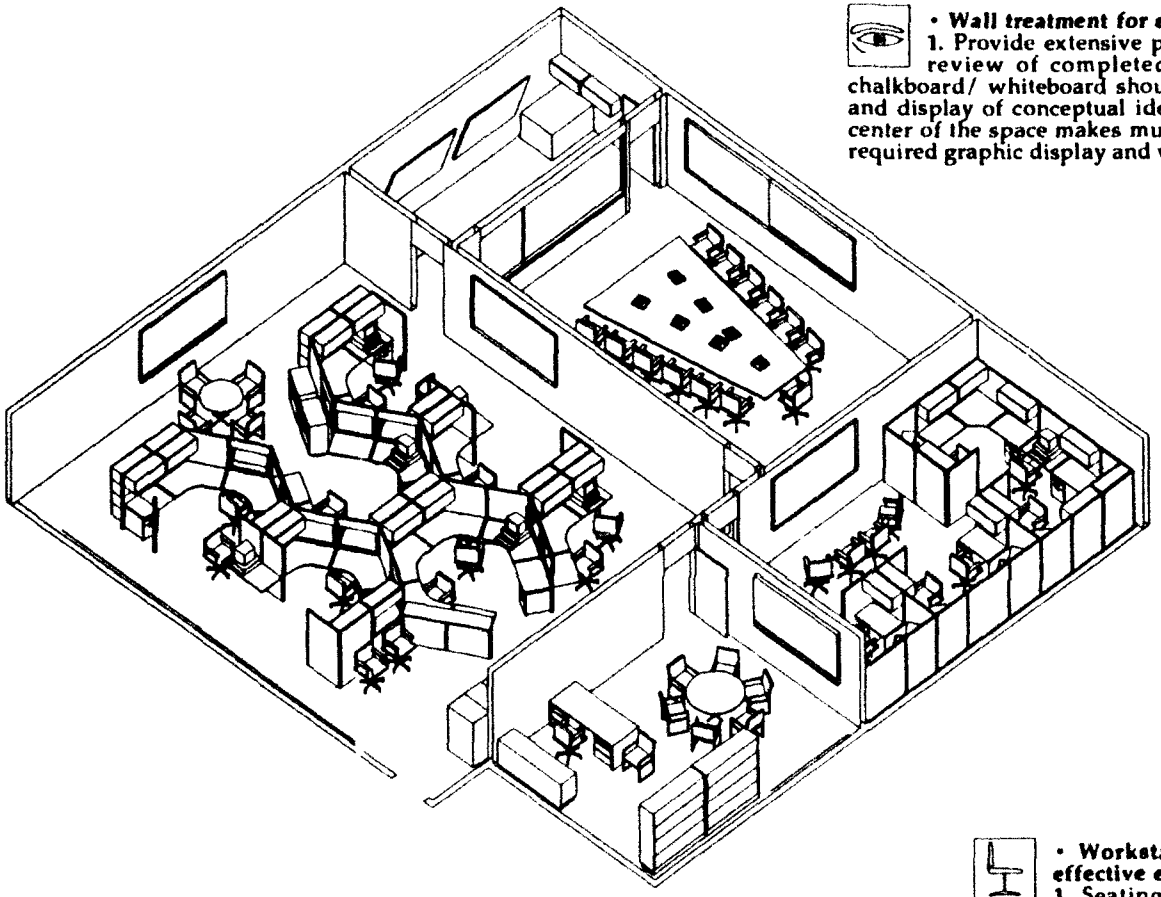
C. 2-4 visitor's chairs
D. Word processor
E. File cabinet(s)
F. Copier(s)
G. Telephone/intercom
H. Sr. action officer workstation:
- Worksurface with storage
- File cabinet(s)
- 2 visitor's chairs
- Ergonomic chair(s)

I. 1-2 group work areas with seating for 4-6 at each
J. Microcomputer (NPES)
K. Conference table with seating for 10-13
L. 1-2 briefing positions w/ control of lighting, communication, and visual displays
M. Rear-screen projection surface
N. Video display terminals
O. SIOP safes
P. Action Officer workstation:
- Worksurface with storage
- File cabinet(s)
- Ergonomic chair(s)

Q. Full communications support
- Commercial
- Autovon
- Red switch
- PA system
- Intercom

R. Link with applicable information databases
S. Whiteboard/display surface
T. Reference material area
U. Bookshelves/map file(s)
V. World clocks

guidance/facility component systems



• **Wall treatment for effective graphic displays:**
1. Provide extensive perimeter wall space to allow for the display and review of completed graphic displays. In addition, a 72" x 48" chalkboard/ whiteboard should be periodically provided for the development and display of conceptual ideas. Arranging the personnel workstations in the center of the space makes much of the perimeter wall surface available for the required graphic display and whiteboards.

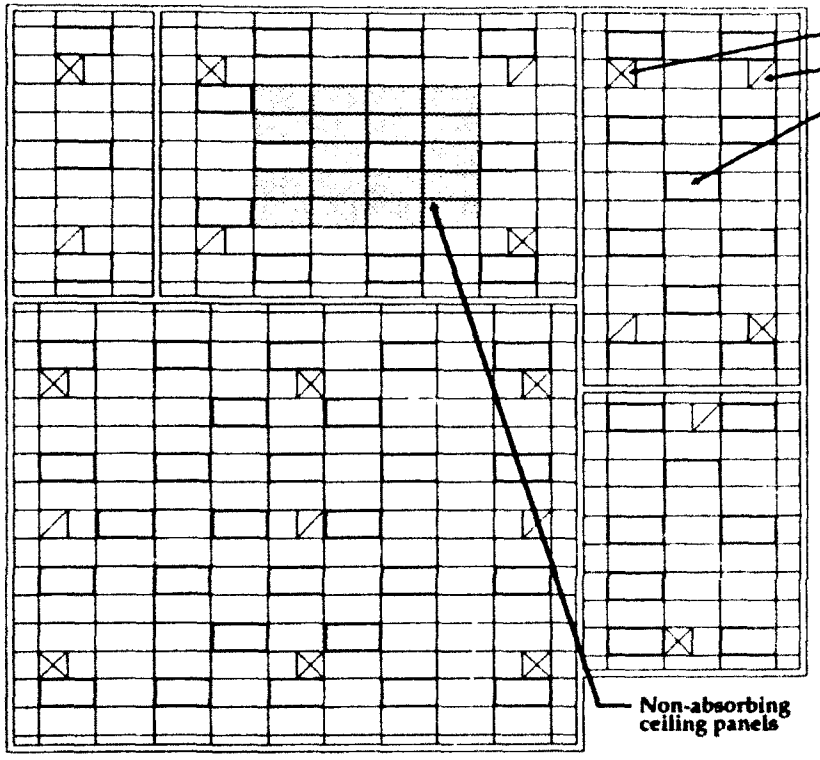
• **Effective separation and/or interconnectivity between personnel workstations:**
1. Divider partitions between workstations should be 60 inches high (+/-4 inches) to provide visual privacy while occupants are seated and yet not be confining.
2. A number of divider partitions between workstations should be able to be opened or closed as required to allow for either direct personnel interaction when open or for visual privacy when closed. These convertible partitions are especially relevant for hexagonal workstation configurations since each module has party partitions with several adjacent modules.

• **Coordination of graphic presentations by briefers:**
The briefers' lectern should contain the necessary communication connectivity to control the automated presentations and/or the necessary communication connection to those who do manual presentations. Such controls must be simple and obvious, since the briefers must primarily concentrate on text. (Ambient lighting controls should be on the room walls adjacent to the lectern rather than being on the lectern itself.)

• **Adequate personnel workstation area and appropriate workstation locations:**
1. Provide the action officer (AO) workstation furniture as a continuous counter without any kneehole constraints. This allows for:
a. maximum amount of desk-type worksurface area available.
b. maximum choice of where AO and equipment can be located and/or co-located, especially when additional AOs are required to augment the assigned personnel for short time periods.
2. Provide the AO system furniture workstations using a standard 36" module throughout. This allows for:
a. easy rearrangement of all components since they will all always be compatible with each other.
b. easy removal of individual desk unit components to accommodate floor- mounted equipment, and then the possible replacement of desk units when the equipment is eventually developed as desktop models.

• **Workstation component and seating adjustability for effective ergonomic interaction:**
1. Seating for virtually all positions, clerical, computer operator, technician, and supervisory, should be of the type that is adjustable to a range of tasks and individual needs. Adjustments should include seat height, backrest height, seat pan tilt, and backrest angle.
2. Machine and computer keyboard surfaces are especially important in terms of adjustability -- height, slope, and angle. Video display terminals must be placed at the proper viewing height and angle, along with being adjustable for individual operator needs. Worksurfaces must be located at the proper height for the specified task and be adjustable to suit individual occupant requirements. Suggested surface heights include:
a. working/writing surface: 26"-31".
b. machine interaction surface: 24"-27".
c. computer keyboard surface: 24"-30".

guidance/facility component systems



REFLECTED CEILING PLAN

• Minimize reflected glare on VDT screens:
1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

• Enable easy ceiling light fixture changes:
1. It is intended that there will be periodic changes in the location of personnel workstations. The ceiling fluorescent light fixtures must be installed in a manner to allow for any fixture unit to be moved to an adjacent ceiling grid module in any direction.

• Optimal acoustic conditions during high activity periods:
1. In order to provide the best working environment within operations spaces that can accommodate up to 30 or 40 persons at one time, it is suggested that the ceiling surface and available wall surface, where practical, be treated with sound-absorbing material. This treatment will allow for the maximum control of within-room noise levels.

• HVAC mechanical system to adequately accommodate electronic-generated heat loads:
1. Heat dissipation by computers, radios, and other electronic equipment is relatively constant; therefore, cooling is required year-round. The room sensible-heat ratio is near unity because heat generated by the computer system is all sensible.
2. The number of required air changes per hour should be 10 to 20 because of the equipment's high heat generation.
3. Humidity control is required year-round to maintain necessary conditions. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components.

• Optimal building mechanical system for equipment protection:
1. An independent air distribution system for electronic equipment spaces is needed.
2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.
3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall oe used in electronic equipment cabinets.
4. Duct fire dampers shall be used in ducts that penetrate two-hour fire resistance-rated walls, partitions, shafts.

• Adequate brightness of projected graphics:
A rear-screen projector with a minimum output of 1000 lumens is recommended for an approximately eight-foot-wide image. Reducing the screen width to approximately six feet permits the use of projectors with a brightness of 600 lumens. WARNING: Large-screen projector images of highly detailed graphics may have limited legibility no matter how bright they are.

• Room acoustic conditions determined by audio system designs:
1. For meeting-type rooms a successful microphone/speaker system depends upon the surface treatment in the room itself. Both the floor and walls should be covered with sound-absorbing materials. The ceiling surface, however, should be reflective over the conference table area and over the observer seating areas.

• Impact of HVAC system noises on acoustical conditions:
Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.

Policy/SOP

Due to the nature of the function of this space, it must be kept in a constant state of operational readiness, 24 hours a day, throughout the year. Depending upon the operational policies of the individual command centers, the Command Briefing Area may also be utilized for day-to-day requirements of the command center as needed. If this situation exists, care must be taken to ensure that no sensitive equipment or briefing material is left exposed or that no other secure portion of the command center is compromised.

C14
COMMAND BRIEFING AREA/ SENIOR BATTLE STAFF (SBS)

function

For the presentation of the information that describes a crisis situation and the alternative courses of action (COAs) for the situation to enable the CINC and the Senior Battle Staff to make their command decisions. The primary location for face-to-face communications between the CINC, Senior Battle Staff, and the Directorates (J-1 thru J-6). For the selection of the specific COA plan to be implemented and the direction of the U.S. forces' response. (This space is also the primary place for most command center briefings -- for training, information, and public relations.)

Space Subfunctions:

Briefings for approval/selection of COAs, plans, and response options by commanders.
5a. Coordinate OPORDS, OPLANS, COAs.
b. Approve and select plans and response options.
c. Select, approve EAM contents and directives.

Order and mission instruction preparation and dissemination.
6a. Prepare, coordinate, and disseminate alert, warning, operations, and mission orders, instructions, and supporting plans; transmit directives.

Hostilities termination and negotiation.
a. Assess termination options, conditions, and proposals.
b. Determine implications of termination.
g. Brief NCA, CINCs, commanders on plan execution/termination, progress and results.

operations

1. Provide presentation of critical information relating to either a crisis or the emerging phases of a crisis situation.
2. Provide a central point for communications links with all applicable systems in support of the Battle Staff decision making process.
3. Provide real-time interaction with information displays and allows for special effects.
4. Provide a communication system for the dissemination of analyses and decisions made during the briefing.

Staff functions and responsibilities for the operation of this space	Primary responsibility for:	Receives input from:	Provides input to:	Performs at:	
Personnel					
Intelligence			●		
Operations	●		●	●	
Logistics			●		
Plans			●		
Comm.-Electronics			●	●	

Staff Participation:

Review of the subfunctions and operations associated with this space suggests this mix of functional staff participation. Note that these are generic allocations of staff participation to generically stated subfunctions and operations; they should only be used as initial concept development factors.

activities

1. Present information to the CINC and prime staff.
2. Present information to the CINC and support staff.
3. Analyze all available information and form decisions.
4. Take records of proceedings.
5. Communicate decisions directly to persons or organization responsible for action.

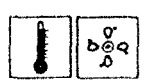
personnel

- CINC and prime staff (4-10)
- Briefers/presenters
- Support staff and other authorized individuals (11-50)

equipment

- Battle Staff conference management table (This table has space for the CINC and prime staff with built-in video display monitors and communications *support equipment*.)
- Battle Staff support conference stations (These provide workspace for the support staff with worksurface and communications support equipment.)
- Seating for 30-40 non-participating persons
- Full communications support:
  - Autovon
  - Commercial
  - Red switch
  - Intercom
  - PA system
- Large-screen display system
- Link with all applicable data information systems (WIS, DISIDS, NIDS)
- 2-4 rear-projection screens
- World clocks
- 2 lecterns with master control panels
- Television/video cameras
- DEFCON status board
- Whiteboard/display surface
- Front projection screen

notes

requirements	criteria	commentary
1. Enough space for the Battle Staff, appropriate support personnel, and associated information display equipment.	1. Enough space shall be provided within the Command Briefing Area to accommodate the Battle Staff Conference Management Table, the Battle Support Staff Stations, and seating for non-participating individuals. Space shall also be provided for all necessary information display and communications equipment. Suggested space allocations would average approximately 75 sq. ft. per member of the Battle Staff and Support Staff, with approximately 10 to 15 sq. ft. per person for non-participating individuals.	1.  Area for approximately 70 requires 2,800 sq. ft. (page C14-6), for 40 requires 1,000 sq. ft. (page C14-10). See Furnishings section in CCDH Volume 3 (page 7-2).
2. A secure environment for the monitoring of sensitive/critical information during crisis and non-crisis situations.	2. The Command Briefing Area shall be located within the facility so that discussion and presentation of sensitive material in the space cannot be compromised. The access to the space must be controlled so that no one may enter without proper clearance. All appropriate equipment in the space must be TEMPEST certified.	2.  See TEMPEST section of the Security Systems in CCDH Volume 3 (page 7-33).
3. Interior finishes suitable for durability, maintenance, and room function.	3. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	3.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
4. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	4. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise (NC) should be between NC 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	4.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
5. Comfort features for the occupant such as chair and furniture systems comfort.	5. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	5.  See Seating section in CCDH Volume 3 (page 7-5).
6. Adequate lighting.	6. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	6.  See Interior Lighting in CCDH Volume 3 (page 7-55).
7. Adequate climate control.	7. Control temp. for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	7.  See HVAC section in CCDH Volume 3 (page 7-65).
8. Accessible power outlets.	8. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall. Provide a raised floor system that allows for easy access to power connections away from the walls.	8. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
9. Fire protection/life safety.	9. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	9.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

guidance/mission support systems for communication, information processing, and briefing and display

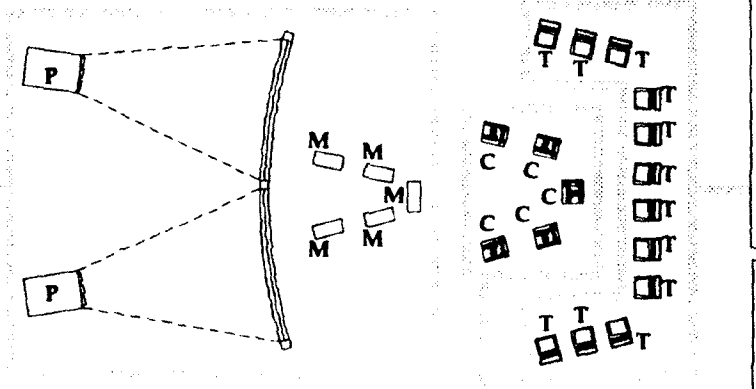
• **Adequate brightness of projected graphics:**
1. A rear-screen projector with a minimum output of 1000 lumens is recommended for an approximately 8-foot wide image. Reducing the screen width to approximately 6 feet permits the use of projectors with a brightness of 600 lumens. **Warning**: Large-screen projector images of highly detailed graphics may have limited legibility no matter how bright they are.

• **Adequate size and quality of LSD images based on distance to primary viewers:**
1. Up to four large screen displays with screen sizes 8 to 12 feet wide.
2. CRT LSD projectors offer highest performance/price tradeoff. Screen sizes from 8 to 10 feet in width employing 8 or 9 inch CRTs can provide adequate displays in a medium-to-low light level room. Projectors employing light-valve technology should be considered for display widths of 10 to 12 feet.

Briefing and Display Subsystem Requirements:
1. Large-screen projection units, either rear-screen units in an adjacent room or self-contained units within the space.
2. Additional TV monitors as required for supplemental displays (CNN, JVIDS, etc.)
3. Audio amplification system with interconnection to other watch and briefing spaces.
4. Display control console, internal or in an adjacent space for local selection of display images.
5. Cameras and microphones to support video teleconferencing.

M=LSD monitor

P=rear screen projector



• **Provide optimal LAN connectivity between the command watch teams:**
1. Structure the LAN topology as "communities -of-interest" group LANs (e.g., CAT space, LCC space, Intel Center space that all have common interface during a crisis event).
2. Limit LAN briefing area applications to those that support command decision-making (e.g., JVIDS, mapping, message handling, database management).

• **Optimum interoperability of the LAN:**
1. In order to take advantage of the IPS currently available, the commands' LAN system will require a UNIX-based platform, and should be compliant with GOSIP, X Window, and Motif standards.
2. AO's connected to the command LAN require terminals similar to UNIX-based integrated workstations.
3. In order to support operations, the LAN requires several laser printers with a minimum of 2 MB of random access memory (RAM).

Information Processing Subsystem Requirements:
1. Computer terminals, connected to all relevant command watch teams, e.g., CSS, Intel, Ops, Logistics, etc.
2. Local Area Network (LAN) with appropriate software capabilities to support immediate data retrieval for decision-makers.

T=computer terminal

Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.

C = communications handset

• **Complete video teleconferencing system:**
1. One or two front wall mounted cameras having 500 lines of resolution, with pan, zoom, and tilt capability for at least one camera. An additional camera can be trained on a white instructional board. Overhead graphics camera will support transmission of images from hardcopy.
2. A three-zone microphone system for the conference table, with either push to talk or voice sensing activation.

• **Convenient local control of LSD images:**
1. Individual keypad or touchscreen local controller to simplify image selection.
2. Local selection of images may be by controller located on podium, however an alternative method of image selection is advisable when briefers do not wish to control images.
3. Requested images should be displayed in acceptable real time of typically 2 to 5 seconds.

• **Adequate numbers and quality of computer terminals:**
1. Necessary types of information (e.g.,messages, maps, TV news) can be sent and received.
2. Undetected data errors are negligible.
3. A computer file that is needed quickly (e.g., a photo) can be delivered electronically within one minute to destinations inside the command center and within 10 minutes to remote destinations.

• **Adequate numbers and quality of the secure/nonsecure telephone units:**
1. Calls to the telephones of key local and distant individuals are established within 10 seconds or less.
2. Voice clarity over all communication paths is equivalent to STU-111 clarity or better.
3. Provide "precedence" capability to assure the most important C3 messages get through first.

guidance/facility component systems

• Space located so the personnel can securely and efficiently interact with others -- especially during crisis events:

1. This functional space should be located within the core of a command center. The desired location is adjacent to or near the Crisis Action Team space.
2. Typical crisis event activities require that this functional space be located within a SCIF.

• Acceptable travel distance within the space to the nearest door during a fire:

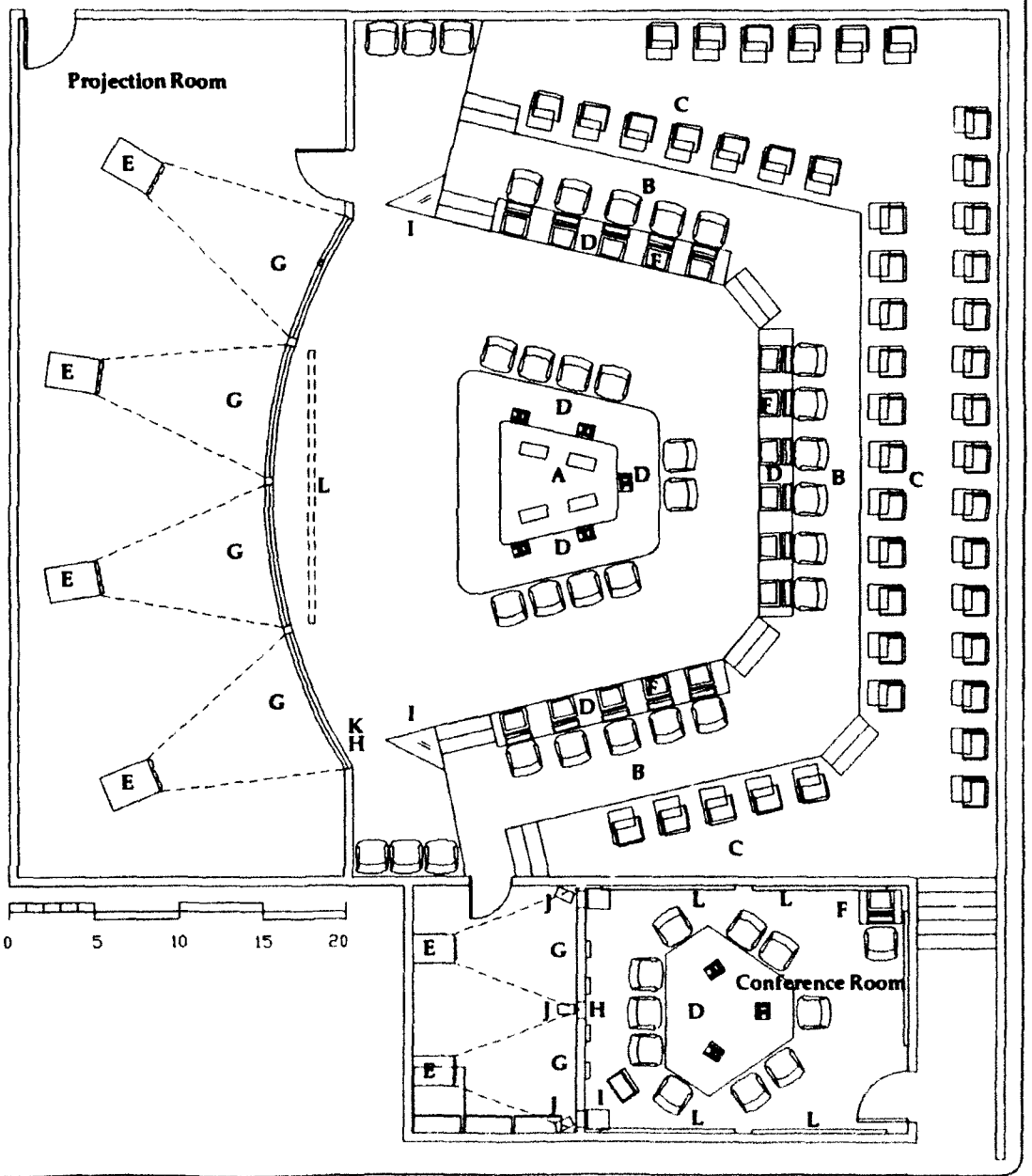
1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)
2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.

• Acceptable travel distance to the nearest building exit during a fire:

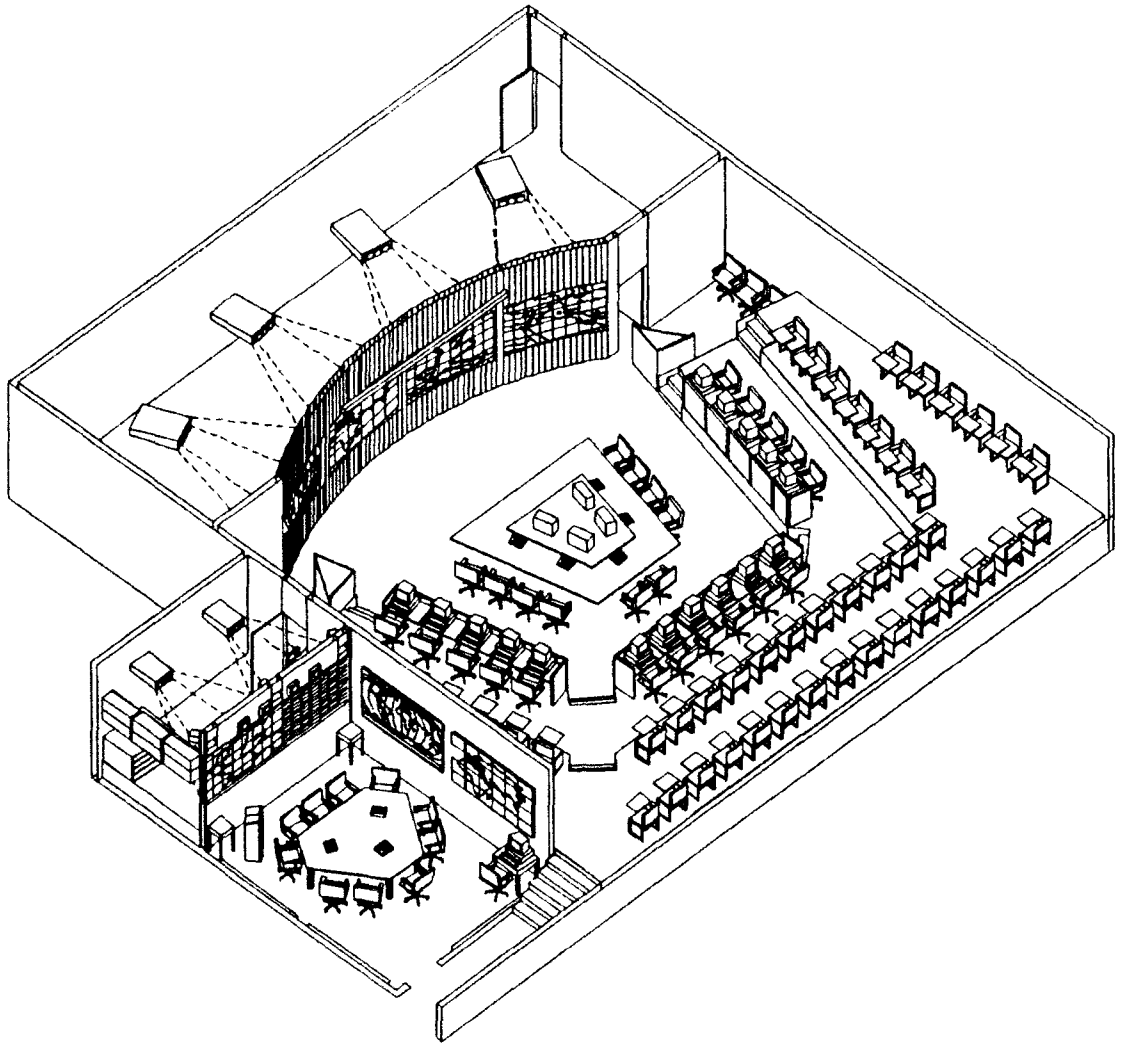
1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)

Equipment List

- **A. Battle staff conference management table (with space for the CINC and prime staff with built-in video display monitors and communications support equipment)**
- **B. Battle staff support conference stations (These provide workspace for the support staff with worksurface and communications support equipment.)**
- **C. Seating for 30-40 non-participating persons**
- **D. Full communications support**
  - **Commercial**
  - **Autovon**
  - **Red switch**
  - **PA system**
  - **Intercom**
- **E. Large-screen display system**
- **F. Link with applicable information databases (WIS, DISIDS, NIDS)**
- **G. 2-4 rear-projection screens**
- **H. World clocks**
- **I. One lectern with display controls**
- **J. TV monitors**
- **K. DEFCON status board**
- **L. Whiteboard/display surface**
- **M. Front projection screen**



guidance/facility component systems



• **Coordination of graphic presentations by briefers:**
The briefers' lectern should contain the necessary communication connectivity to control the automated presentations and/or the necessary communication connection to those who do manual presentations. Such controls must be simple and obvious, since the briefers must primarily concentrate on text. (Ambient lighting controls should be on the room walls adjacent to the lectern rather than being on the lectern itself.)

• **Room acoustic conditions determined by audio system designs:**
1. For meeting-type rooms a successful microphone/speaker system depends upon the surface treatment in the room itself. Both the floor and walls should be covered with sound-absorbing materials. The ceiling surface, however, should be reflective over the conference table area and over the observer seating areas.

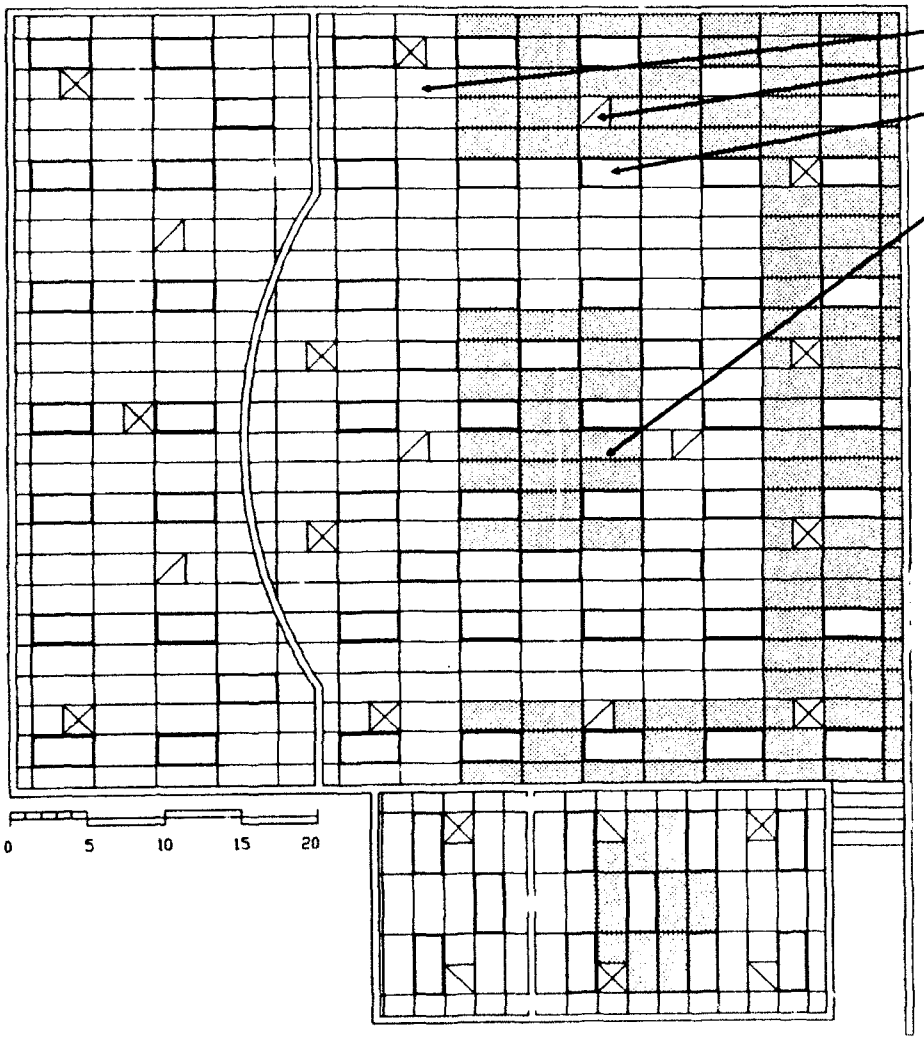
• **Optimal acoustic conditions during high activity periods:**
1. In order to provide the best working environment within operations spaces that can accommodate up to 30 or 40 persons at one time, it is suggested that the ceiling surface and available wall surface, where practical, be treated with sound-absorbing material. This treatment will allow for the maximum control of within-room noise levels.

• **Wall treatment for effective graphic displays:**
1. Provide extensive perimeter wall space to allow for the display and review of completed graphic displays. In addition, a 72" x 48" chalkboard/ whiteboard should be periodically provided for the development and display of conceptual ideas. Arranging the personnel workstations in the center of the space makes much of the perimeter wall surface available for the required graphic display and whiteboards.

• **Adequate brightness of projected graphics:**
A rear-screen projector with a minimum output of 1000 lumens is recommended for an approximately eight-foot-wide image. Reducing the screen width to approximately six feet permits the use of projectors with a brightness of 600 lumens. WARNING: Large-screen projector images of highly detailed graphics may have limited legibility no matter how bright they are.

guidance/facility component systems

REFLECTED CEILING PLAN



• Impact of HVAC system noises on acoustical conditions:
Noise from both the air-handling units themselves and the turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.

• Minimize reflected glare on projection screens and VDT screens:

1. To reduce glare on display screens and terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be *helpful*. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the display screens and the VDTs. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

• HVAC mechanical system to adequately accommodate people, projectors, and computer-generated heat loads:

1. Heat dissipation by large groups, projectors, and computers is relatively constant; therefore, cooling is required year-round. The room sensible heat ratio is near unity because heat generated by the projector and computer systems is all sensible.
2. The number of required air changes per hour should be 10 to 20 because of the potential for the equipment's high heat generation.
3. Humidity control is required year-round to maintain necessary conditions in the briefing room.

guidance/mission support systems for communication, information processing, and briefing and display

NOTE: The Command Briefing Area shown on pages C14-9 through C14-12 is a smaller version of Space C14. The information shown on pages C14-1 thru C14-4 also applies to this smaller configuration.

• Optimal connection to projectors and monitors:
1. Provide fiber optic cables for all connections to the projectors and monitors.
2. Provide local selectors for video source selection at each projector and monitor.

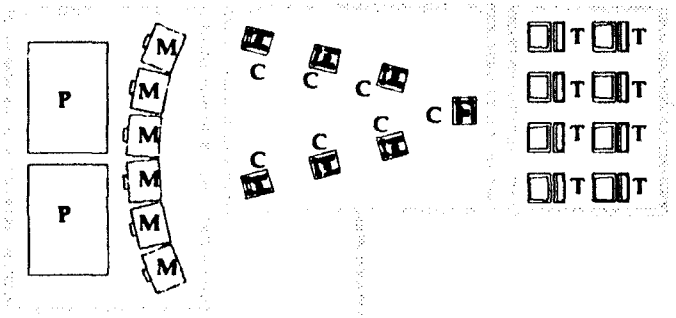
• Maintain consistent image quality for both small-screen monitors and large-screen projectors:
1. Use high-bandwidth video distribution amplifiers (100 Megahertz) to duplicate large-screen images on monitors.
2. High quality video decoders will improve the LS display of TV signals (NBC,ABC,CBS,CNN).

• Provide optimal LAN connectivity between the command watch teams:
1. Structure the LAN topology as "communities -of-interest" group LANs (e.g., CAT space, LCC space, Intel Center space that all have common interface during a crisis event).
2. Limit LAN briefing area applications to those that support command decision-making (e.g., JVIDS, mapping, message handling, database management).

• Optimum interoperability of the LAN:
1. In order to take advantage of the IPS currently available, the commands' LAN system will require a UNIX-based platform, and should be compliant with GOSIP, X Window, and Motif standards.
2. AO's connected to the command LAN require terminals similar to UNIX-based integrated workstations.
3. In order to support operations, the LAN requires several laser printers with a minimum of 2 MB of random access memory (RAM).

Briefing and Display Subsystem Requirements:
1. Large-screen projection units, either rear-screen units in an adjacent room or self-contained units within the space.
2. Additional TV monitors as required for supplemental displays (CNN, JVIDS, etc.)
3. Audio amplification system with interconnection to other watch and briefing spaces.
4. Display control console, internal or in an adjacent space for local selection of display images.

P=self contained LSD projector



Information Processing Subsystem Requirements:
1. Computer terminals, connected to all relevant command watch teams, e.g., CSS, Intel, Ops, Logistics, etc.

T = computer terminal

Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.

C = communications handset

• Adequate numbers and quality of the secure/nonsecure telephone units:
1. Calls to the telephones of key local and distant individuals are established within 10 seconds or less.
2. Voice clarity over all communication paths is equivalent to STU-111 clarity or better.
3. Provide "precedence" capability to assure the most important C3 messages get through first.

• Adequate audio speaker system for briefings:
1. Multiple 6 or 8 inch ceiling speakers should be placed throughout the room to assure all personnel are within hearing range without excessive volume.
2. In addition to a master volume control, individual volume controls are recommended at the podium and at a location convenient to the conference table.

• Adequate numbers and quality of computer terminals:
1. Necessary types of information (e.g.,messages, maps, TV news) can be sent and received.
2. Undetected data errors are negligible.
3. A computer file that is needed quickly (e.g., a photo) can be delivered electronically within one minute to destinations inside the command center and within 10 minutes to remote destinations.

• Adequate size and quality of LS monitors based on distance to primary viewers:
1. Three to five multiple large screen displays with image sizes between 30 inches (diagonal) and 67 inches (diagonal). For high-scan rate displays, consideration may be given to using 48 or 67 inch (diagonal) self-contained projectors.
2. Large-screen monitors are available that provide display sizes from 30 inches (diagonal) to 37 inches (diagonal). Monitor selection is dependent upon video source signals to be displayed. Large video monitors are generally limited to 15 to 36 kilohertz horizontal scan rates. Scan converters may be necessary.
3. Individual monitor speakers or a single switchable speaker may be employed for television audio. A third alternative is to route television signals to one display only with audio following video to a dedicated speaker. Adjustment of speaker volume should be accessible at the podium and the conference table.

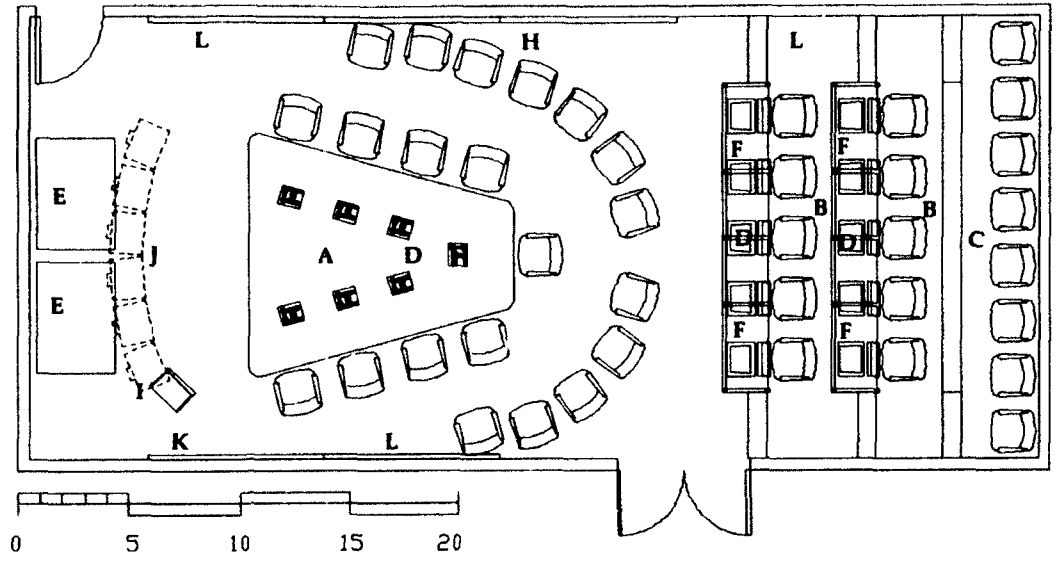
guidance/facility component systems

• Acceptable travel distance within the space to the nearest door during a fire:
1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)
2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.

• Acceptable travel distance to the nearest building exit during a fire:
1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)

• Effective conferencing activities for group coordination and planning:
1. Provide conference table and chairs adjacent to lead personnel workstation.
2. Provide whiteboard display surface with mounting ledge (approx. 96" x 48").

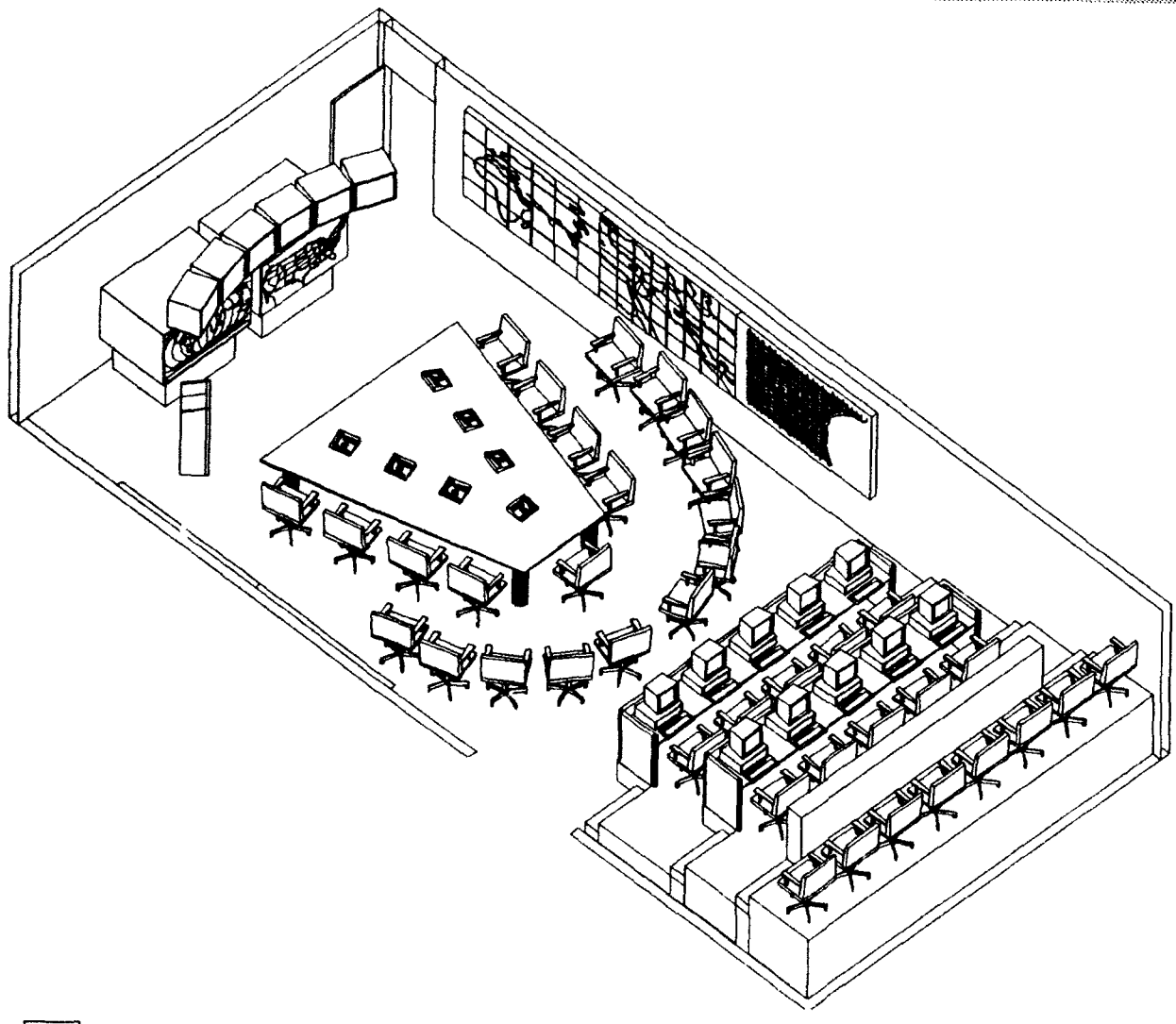
• Space located so the personnel can securely and efficiently interact with others -- especially during crisis events:
1. This functional space should be located within the core of a command center. The desired location is adjacent to or near the Crisis Action Team space.
2. Typical crisis event activities require that this functional space be located within a SCIF.



Equipment List

A. Battle staff conference management table (with space for the CINC and prime staff with built-in video display monitors and communications support equipment)
B. Battle staff support conference stations (These provide workspace for the support staff with worksurface and communications support equipment.)
C. Seating for 30-40 non-participating persons
D. Full communications support
   - Commercial
   - Autovon
   - Red switch
   - PA system
   - Intercom
E. Large-screen display system
F. Link with applicable information databases (WIS, DISIDS, NIDS)
G. 2-4 rear-projection screens
H. World clocks
I. One lectern with display controls
J. TV monitors
K. DEFCON status board
L. Whiteboard/display surface
M. Front projection screen

guidance/facility component systems

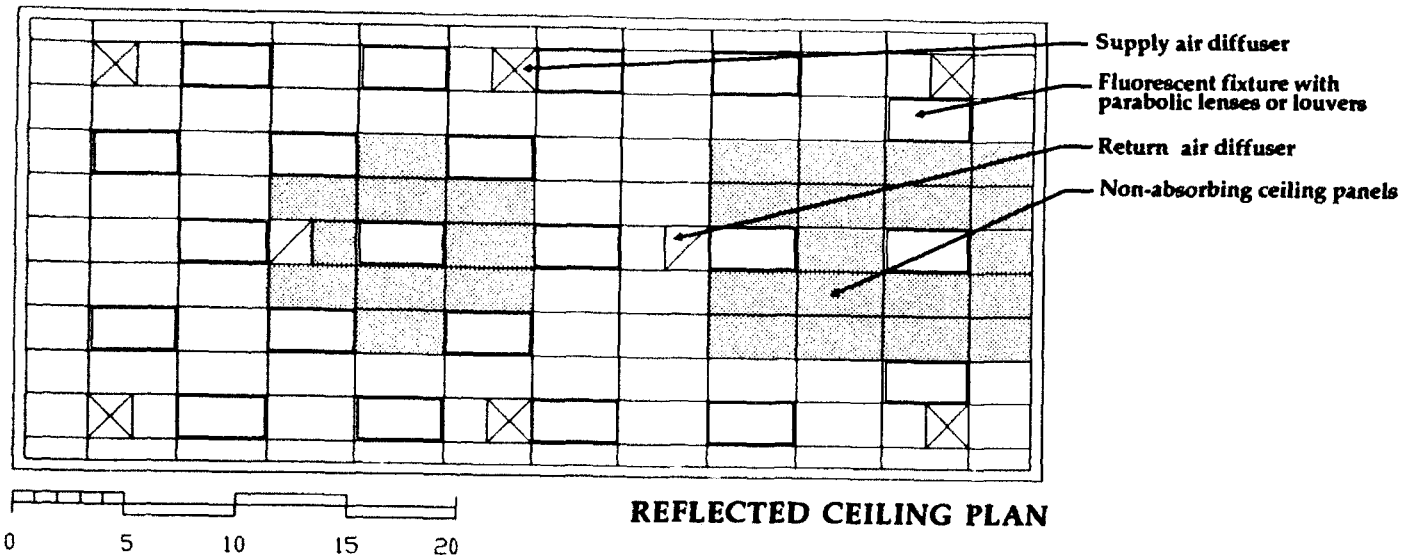


• Coordination of graphic presentations by briefers:
The briefers' lectern should contain the necessary communication connectivity to control the automated presentations and/or the necessary communication connection to those who do manual presentations. Such controls must be simple and obvious, since the briefers must primarily concentrate on text. (Ambient lighting controls should be on the room walls adjacent to the lectern rather than being on the lectern itself.)

• Room acoustic conditions determined by audio system designs:
1. For meeting-type rooms a successful microphone/speaker system depends upon the surface treatment in the room itself. Both the floor and walls should be covered with sound-absorbing materials. The ceiling surface, however, should be reflective over the conference table area and over the observer seating areas.

• Optimal acoustic conditions during high activity periods:
1. In order to provide the best working environment within operations spaces that can accommodate up to 30 or 40 persons at one time, it is suggested that the ceiling surface and available wall surface, where practical, be treated with sound-absorbing material. This treatment will allow for the maximum control of within-room noise levels.

guidance/facility component systems



REFLECTED CEILING PLAN

• Minimize reflected glare on VDT screens:

1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

• HVAC mechanical system to adequately accommodate electronic-generated heat loads:

1. Heat dissipation by computers, radios, and other electronic equipment is relatively constant; therefore, cooling is required year-round. The room sensible-heat ratio is near unity because heat generated by the computer system is all sensible.
2. The number of required air changes per hour should be 10 to 20 because of the equipment's high heat generation.
3. Humidity control is required year-round to maintain necessary conditions. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components.

• Impact of HVAC system noises on acoustical conditions:

Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.

Policy/SOP

Command center policy will dictate whether if this space is required. In the case of the NMCC, the space provides the SECDEF with a private workspace at the heart of the command center where informal information briefings may be held.

NOTE:

In some command centers the function of the Senior Authority Room may be accomplished within the CINC Conference Room, which also functions as a remote workspace for the CINC.

C15
SENIOR AUTHORITY ROOM

function

For the workstation of the CINC and/or other designated senior authority near the CAT/BSSC area for immediate use during a crisis situation. The space provides for convenient small-group discussions (rather than for information display briefings) to assist the Senior Battle Staff in their decision making process.

Space Subfunctions:

5a. Coordinate OPORDS, OPLANS, COAs.
b. Approve and select plans and response options.
c. Select and approve EAM contents and directives.

6a. Prepare, coordinate and disseminate alert, warning, operations, and mission orders, instructions and supporting plans; transmit directives.

9b. Determine implications of termination.
c. Assess feasibility of termination; determine degree to which objectives have been achieved.
d. Define terms of termination.
e. Terminate hostilities and active operations.
f. Support negotiations.
g. Brief NCA, CINCs, commanders on plan execution/termination, progress, and results.
h. Prepare, coordinate, disseminate operations termination orders.

operations

1. Provide a remote workspace for a designated senior authority within a command center.
2. Provide for information and situation briefings within the workspace.
3. Provide a communications and information link with the CAT.
4. Provide for private communications and conferences.
5. Provide for secure teleconferencing.

Staff functions and responsibilities for the operation of this space	Primary responsibility for:	Receives input from:	Provides input to:	Performs at:
Personnel		●		
Intelligence		●		
Operations	●	●		●
Logistics		●		
Plans		●		●
Comm.-Electronics		●	●	

Staff Participation:

Review of the subfunctions and operations associated with this space suggests this mix of functional staff participation. Note that these are generic allocations of staff participation to generically stated subfunctions and operations; they should only be used as initial concept development factors.

activities

1. Perform informal monitoring.
2. Send/receive messages.
3. Receive information briefings.
4. Hold informal conferences.

personnel

- Senior Authority
- 1-10 visitors/observers
- 1-2 briefers

equipment

- Senior authority workstation:
  - Worksurface with storage
  - Telephone/communications console
  - Ergonomic chair
- Conference table with 8 chairs
- 2-4 visitor's chairs
- Wall displays/charts
- TV monitors
- Red and black telephones
- FGC-56
- TT-47
- Enclosed booth for private conversations (optional)

notes

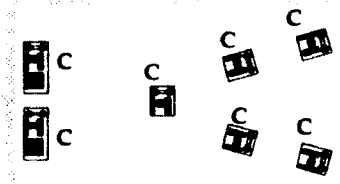
requirements	criteria	commentary
1. Enough space for the briefing and display of information to designated senior authority and selected staff members.	1. The Senior Authority Room should be large enough to house a workstation for the senior authority, as well as a conference/briefing area for 5 to 10 people. Area required should range from 600 to 700 sq. ft., depending upon the amount and type of equipment and information display systems.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. A secure environment for the monitoring of sensitive/critical information during crisis and non-crisis situations.	2. The Senior Authority Room shall be located within the facility so that discussion and presentation of sensitive material in the space cannot be compromised. The access to the space must be controlled so no one may enter without proper clearance. All appropriate equipment in the space must be TEMPEST certified.	2.  See TEMPEST section of the Security Systems in CCDH Volume 3 (page 7-33).
3. Interior finishes suitable for durability, maintenance, and room function.	3. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	3.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
4. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	4. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise (NC) should be between NC 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	4.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
5. Comfort features for the occupant such as chair and furniture systems comfort.	5. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	5.  See Seating section in CCDH Volume 3 (page 7-5).
6. Adequate lighting.	6. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	6.  See Interior Lighting in CCDH Volume 3 (page 7-55).
7. Adequate climate control.	7. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	7.  See HVAC section in CCDH Volume 3 (page 7-65).
8. Accessible power outlets.	8. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall.	8. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
9. Fire protection/life safety.	9. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	9.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

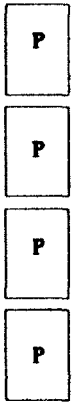
guidance/mission support systems for communication, information processing, and briefing and display

• Adequate numbers and quality of the secure/nonsecure telephone units:
1. Calls to the telephones of key local and distant individuals are established within 10 seconds or less.
2. Voice clarity over all communication paths is equivalent to STU-111 clarity or better.
3. Provide "precedence" capability to assure the most important C3 messages get through first.

Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.

C = communications handset





• Convenient local control of LSD images:
1. Individual keypad or touchscreen local controller to simplify image selection.
2. Local selection of images may be by controller located on podium, however an alternative method of image selection is advisable when briefers do not wish to control images.
3. Requested images should be displayed in acceptable real time of typically 2 to 5 seconds.

Briefing and Display Subsystem Requirements:
1. Audio amplification system with interconnection to other watch and briefing spaces.
2. Display control console, internal or in an adjacent space for local selection of display images.
3. Video monitors of adequate number and size that will accept all required image signals.

M = LSD monitor

• Maintain consistent image quality for both small-screen monitors and large-screen projectors:
1. Use high-bandwidth video distribution amplifiers (100 Megahertz) to duplicate large-screen images on monitors.
2. High quality video decoders will improve the LS display of TV signals (NBC,ABC,CBS,CNN).

• Adequate size and quality of LS monitors based on distance to primary viewers:
1. Three to five multiple large screen displays with image sizes between 30 inches (diagonal) and 67 inches (diagonal). For high-scan rate displays, consideration may be given to using 48 or 67 inch (diagonal) self-contained projectors.
2. Large-screen monitors are available that provide display sizes from 30 inches (diagonal) to 37 inches (diagonal). Monitor selection is dependent upon video source signals to be displayed. Large video monitors are

guidance/facility component systems



• Effective conferencing activities for group coordination and planning:
1. Provide conference table and chairs adjacent to lead personnel workstation.
2. Provide whiteboard display surface with mounting ledge (approx. 96" x 48").



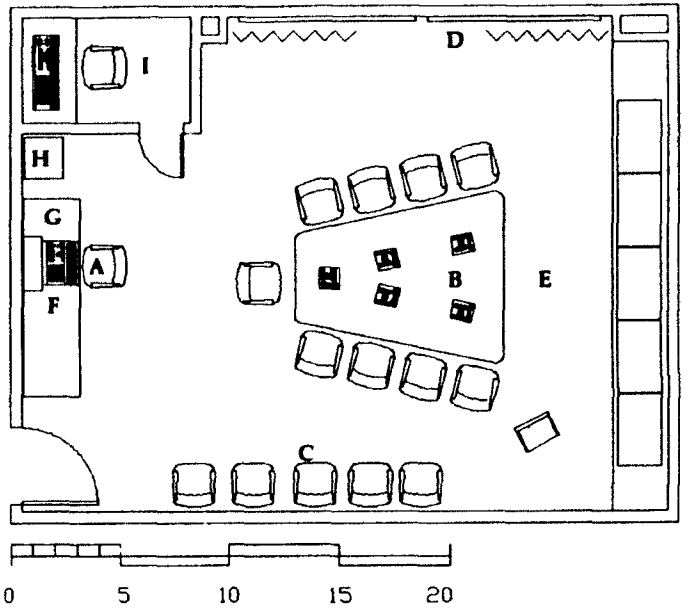
• Space located so the personnel can securely and efficiently interact with others -- especially during crisis events:
1. This functional space should be located within the core of a command center. The desired location is adjacent to or near the Crisis Action Team space.
2. Typical crisis event activities require that this functional space be located within a SCIF.



• Acceptable travel distance within the space to the nearest door during a fire:
1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)
2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.



• Acceptable travel distance to the nearest building exit during a fire:
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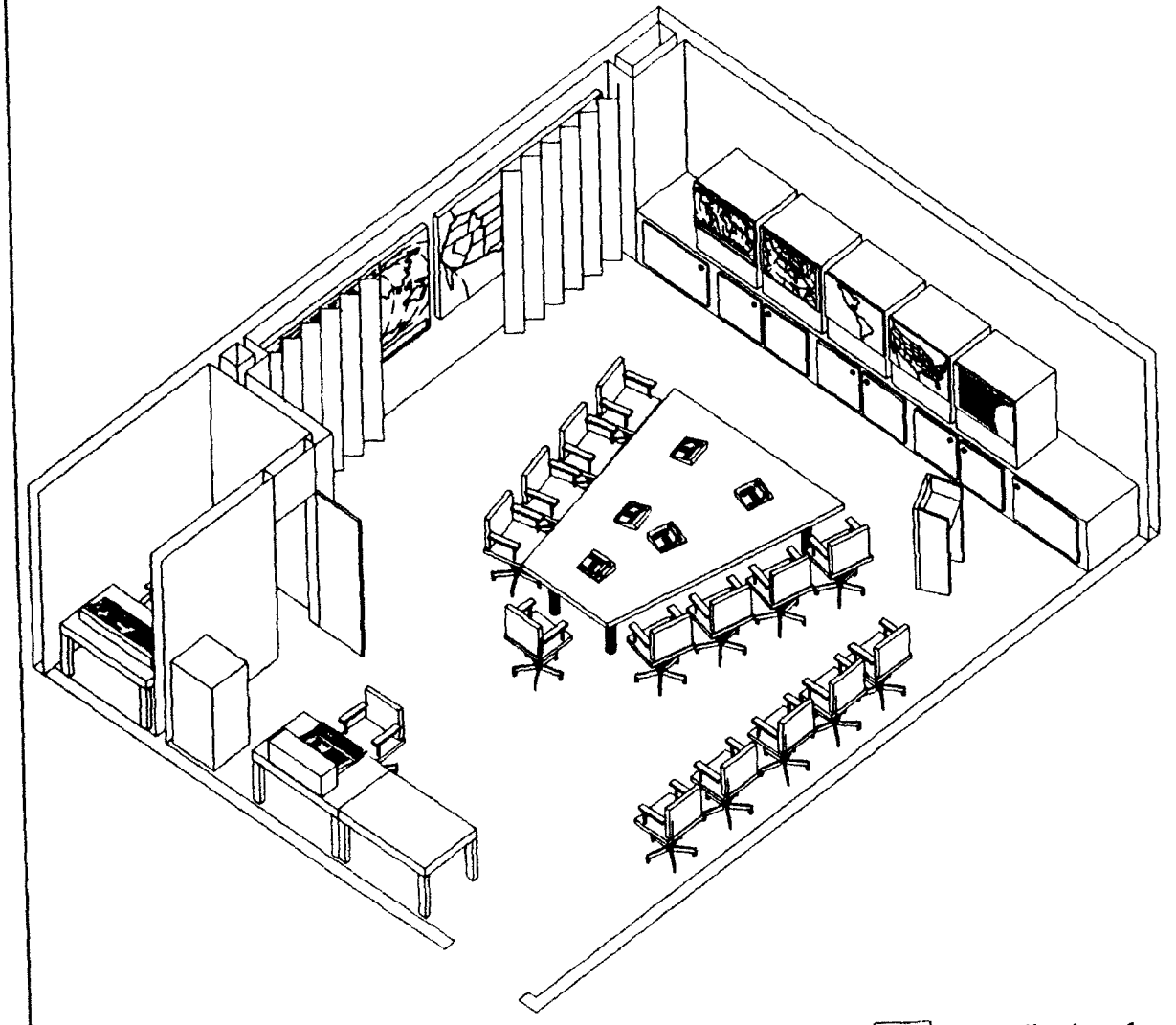


Equipment List

A. Senior authority workstation:
- **Worksurface with storage**
- **Telephone/communications console**
- **Ergonomic chair**

B. Conference table with 8 chairs
C. 2-4 visitor's chairs
D. Maps, charts, displays
E. TV monitors
F. Red/black telephones
G. FGC-56
H. TT-47
I. Enclosed booth for private conversations (optional)

guidance/facility component systems

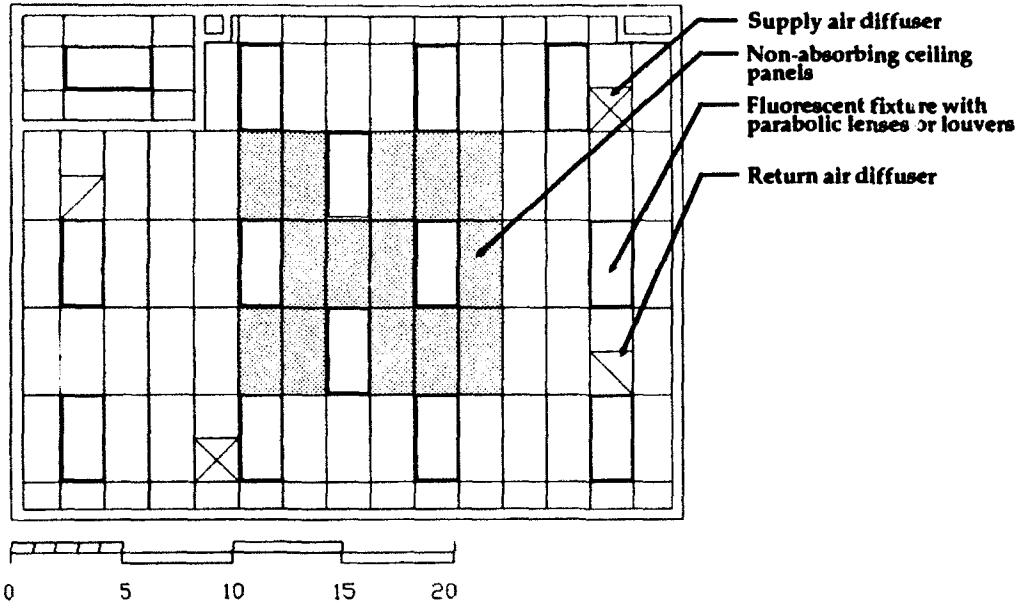


• **Wall treatment for effective graphic displays:**
1. Provide extensive perimeter wall space to allow for the display and review of completed graphic displays. In addition, a 72" x 48" chalkboard/ whiteboard should be periodically provided for the development and display of conceptual ideas. Arranging the personnel workstations in the center of the space makes much of the perimeter wall surface available for the required graphic display and whiteboards.

• **Coordination of graphic presentations by briefers:**
The briefers' lectern should contain the necessary communication connectivity to control the automated presentations and/or the necessary communication connection to those who do manual presentations. Such controls must be simple and obvious, since the briefers must primarily concentrate on text. (Ambient lighting controls should be on the room walls adjacent to the lectern rather than being on the lectern itself.)

guidance/facility component systems

REFLECTED CEILING PLAN



• Minimize reflected glare on VDT screens:
1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

• Optimal building mechanical system for equipment protection:
1. An independent air distribution system for electronic equipment spaces is needed.
2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.
3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall be used in electronic equipment cabinets.
4. Duct fire dampers shall be used in ducts that penetrate two-hour fire resistance-rated walls, partitions, shafts.

• Room acoustic conditions determined by audio system designs:
1. For meeting-type rooms a successful microphone/speaker system depends upon the surface treatment in the room itself. Both the floor and walls should be covered with sound-absorbing materials. The ceiling surface, however, should be reflective over the conference table area and over the observer seating areas.

• Impact of HVAC system noises on acoustical conditions:
Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.

• Enable easy ceiling light fixture changes:
1. It is intended that there will be periodic changes in the location of personnel workstations. The ceiling fluorescent light fixtures must be installed in a manner to allow for any fixture unit to be moved to an adjacent ceiling grid module in any direction.

Policy/SOP

The Deployment Actions Center for the Deployment Actions Team (DAT) must be maintained in a constant state of readiness for possible activation at any time. Equipment and systems must be periodically tested and routine maintenance completed as scheduled. Upon completion of an exercise or the termination of a crisis situation, the Deployment Action Center must be deactivated and returned to a state of readiness.

C16
DEPLOYMENT ACTIONS CENTER/ DAT

function

For the coordination, management, and consolidation of activities related to the deployment of forces and monitoring of deployment actions at a command center.

Space Subfunctions:

2a. *Monitor, determine, and display* the status of readiness of all U.S. forces and resources (F/R) (including active and reserve elements) and non-U.S. F/R worldwide (including nuclear force status and weapons).
b. Identify and display unit, resources, facilities, communications, and weapons system characteristics and capabilities, planning factors, and performance data.
c. Identify critical logistic resources.
d. Identify the location and status of airlift and sealift assets.
e. Assess force operational readiness capability and availability; identify the deployable status of designated forces.

4a. Formulate operations objectives and schedule resource utilization.
b. Generate and refine F/R requirements and options, movement requirements, resupply, and non-unit personnel requirements.
c. *Merge, modify* and tailor force lists and force movement requirements to crisis operations.
d. Develop and evaluate potential courses of action (COA) including the definition of COAs and operations for situations that may require the use of U.S. military forces. COA development is normally very time-sensitive and involves the determination of forces, logistics support, personnel, and transportation requirements to support contingencies for which no plans exist.
e. Match and select COA/OPLAN force and movement requirements with actual F/R, and allocate F/R to plans. Includes use of U.S. and/or Allied military forces and material, and host nation support.
f. Determine and allocate F/R to special logistics requirements such as engineering, POL, ammunition, medical, and other critical areas, as applicable.
g. Perform plan analysis; determine COA/OPLAN force logistics and transportation availability and feasibility. Identify logistics, transportation, and personnel shortfalls; assess adequacy of plans to achieve objectives, considering intelligence inputs.
h. Assess projected capabilities to satisfy sustainment requirements for long-range COAs and contingency operations.
i. Coordinate deployment routing, air refueling, and scheduling; develop and refine movement tables and schedules.
j. Perform sortie timing, routing, and target assessment; perform reconnaissance planning.
k. Provide for mobilization of reserves and marshaling of logistics resources.

function

l. Consider generation and coordination of retrograde operations for withdrawal of U.S. and Allied forces and resources from foreign countries. Includes the planning of evacuation activities for U.S. and Allied nationals.
m. Present plans to decision makers.

5a. Coordinate OPORDS, OPLANS, COAs.
b. Approve and select plans and response options.

8b. Monitor the deployment of forces and material; monitor shipment status.
c. Provide real-time crisis management information to include force movement and logistic data.
d. Monitor force generation.
f. Monitor the reception and onward movement of deploying forces and resources within theaters of operation.
g. Monitor the movement and withdrawal of F/R from objective areas in other countries, determination of withdrawal progress, and identification of problem areas. Also includes monitoring the withdrawal of U.S. and Allied civilian personnel from foreign territories.
l. Compare operations reports with operational objectives and events to determine effectiveness and identify shortfalls.

DAC: DEPLOYMENT ACTIONS TEAM (DAT) DEPLOYMENT OPS AREA

operations

1. Provide a center for the coordination and monitoring of deployment actions within the command center.
2. Provide information as required relating to the status of deployment actions.
3. Provide information and recommendations relating to transportation assets in support of force deployment and retrieval of casualties.
4. Provide required connectivity with appropriate outside agencies and information sources.
5. Provide deployment information database.
6. Provide administrative support to the (DAT).
7. Provide ADP support to the DAT.
8. Provide information briefings as required.

Staff functions and responsibilities for the operation of this space	Primary responsibility for:	Receives input from:	Provides input to:	Performs at:
Personnel		●		
Intelligence		●		
Operations		●	●	●
Logistics	●	●		●
Plans		●	●	●
Comm.-Electronics			●	

Staff Participation:

Review of the subfunctions and operations associated with this space suggests this mix of functional staff participation. Note that these are generic allocations of staff participation to generically stated subfunctions and operations; they should only be used as initial concept development factors.

activities:

1. Coordinate and monitor planning and execution actions.
2. Analyze deployment status.
3. Prepare deployment recommendations.
4. Maintain communication links.
5. Brief CINC and Battle Staff as required.

personnel

- DAT team chief
- Executive officer
- 2 functional section chiefs
- 4-8 action officers

equipment

- Main DAT console/DAT chief workstation:
  - WWMCCS terminal with side printer
  - Communications support
  - Full visual display control panel
- Executive officer workstation:
  - Terminal
  - Applicable communications support
- NCO administrator workstation:
  - Automated message handling system (AMHS)
  - Applicable communications support
- DAT team deployment management station:
  - These stations shall *accommodate all members* of the DAT along with all necessary communication *support, and computer/* information database links.
- Full communications support:
  - *Commercial*
  - Autosevocom
  - Red switch
  - Intercom
  - PA system
  - Autovon
- *Link with all applicable* databases
- Wall chart, maps
- Rear-screen projection system (1-2 screens)
- Lectern with display control
- TV monitors

DEPLOYMENT ACTIONS CENTER: DAT OPS BRIEFING AREA

activities:

1. Monitor/direct DAT briefings.
2. Support briefing visual display needs.
3. Observe DAT operation activities.

personnel

- 1 briefing support person
- Up to 10 personnel for observation of DAT operations

equipment

- Briefing support workstation:
  - Console with control of visual display devices located in the DAT. (In addition the console will have applicable communications support and DAT area lighting controls.)
  - Ergonomic chair
- Observation workstation:
  - Shared worksurface or worktable
  - Communications support
  - Ergonomic chair
- WISCUS workstation
- Honeywell 7705 with printer

DAC: DEPLOYMENT ACTIONS CENTER: ADMINISTRATIVE SUPPORT AREA

activities:

1. Retrieve and replace file reference material as required by DAT.
2. Screen personnel for entry into DAC.
3. Screen, log, and relay messages as required.
4. Maintain adequate storage/inventory of supplies as needed.
5. Answer phones.
6. Maintain significant events information board.
7. Access WIN
8. Accomplish message input/output in WIN teleconferences.
9. Pick up, log, file, deliver, and pass all incoming and outgoing DAT autodin and WIN messages.
10. Prepare/type messages and other documentation as necessary.
11. Deactivate DAC upon completion of exercise or termination of situation.

personnel

- DAT NCOIC
- 1 administrative specialist
- 1 WIN operator
- 1 clerk/typist

equipment

- NCOIC workstation:
  - Worksurface with storage
  - File cabinet
  - Bookcase
  - Ergonomic chair
- Typist workstation:
  - Worksurface with storage
  - Machine surface
  - Printer with stand
  - Supply storage
  - Ergonomic chair
- Terminal(s)/printer(s)
- Word processor
- AMHS
- WIN terminal
- MOD-40 teletype
- Communications support
- General DAC supplies storage
- Copy machine

DAC: DAT FUNCTIONAL DATABASE MANAGEMENT (FBDM) AREA

activities:

1. Establish and maintain WIN teleconferences.
2. Maintain database integrity.
3. Prepare required data output reports for DAT.
4. Coordinate systems operations with other agencies.
5. Assist other agencies as required with transfer of data.
6. Prepare and maintain a complete log of actions, unresolved issues, and actions not yet completed.
7. Resolve systems and/or database problems as needed.
8. Pick up and distribute reports as needed to support DAT and deployment sections.

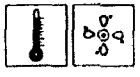
personnel

- Chief systems manager
- 1 database NCO (per shift)
- 1 systems specialist (per shift)

equipment

- *Chief's workstation:*
  - Worksurface with storage
  - Bookcase
  - File cabinet
  - Terminal
  - Printer
  - Ergonomic chair
- Personnel workstations:
  - Worksurface with storage
  - Bookcases
  - Ergonomic chair
- Communications support
- Honeywell 7705(s) with printers(s)
- WISCUS workstation
- RLP
- AMHS

notes

requirements	criteria	commentary
1. Enough space to accommodate the equipment and personnel associated with the Deployment Actions Center and necessary to accomplish the mission of the DAT.	1. Space shall be provided for the planning and management of deployment actions in relation to either day-to-day or crisis operations. The space may be divided or sub-divided into additional areas as required by the organizational structure of the specific command center. Space has been apportioned into three general areas as follows: Briefing Area 600 sq. ft. Operations Area 1000 sq. ft. Projection Room 175 sq. ft.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. A secure environment for the monitoring of sensitive/critical information during crisis and non-crisis situations.	2. The Deployment Actions Center shall be located within the facility so that discussion and presentation of sensitive material in the space cannot be compromised. The access to the space must be controlled so no one may enter without proper clearance. All appropriate equipment in the space must be TEMPEST certified.	2.  See TEMPEST section of the Security Systems in CCDH Volume 3 (page 7-33).
3. Interior finishes suitable for durability, maintenance, and room function.	3. ***Floors*** *Anti-static carpet in roll goods or tiles over non-dusting,* hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	3.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
4. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	4. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise (NC) should be between NC 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	4.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
5. Comfort features for the occupant such as chair and furniture systems comfort.	5. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	5.  See Seating section in CCDH Volume 3 (page 7-5).
6. Adequate lighting.	6. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	6.  *See Interior Lighting* in CCDH Volume 3 (page 7-55).
7. Adequate climate control.	7. Control temp. for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	7.  See HVAC section in CCDH Volume 3 (page 7-65).
8. Accessible power outlets.	8. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall. Provide a raised floor system that allows for easy access to power connections away from the walls.	8. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
9. Fire protection/life safety.	9. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	9.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

guidance/mission support systems for communication, information processing, and briefing and display

• **Optimal connection to projectors and monitors**:
1. Provide fiber optic cables for all connections to the projectors and monitors.
2. Provide local selectors for video source selection at each projector and monitor.

• **Adequate communication switching capacity**:
1. The internal and external communication connectivity needs to be optimal during peak crisis periods. Lead team personnel should have state-of-the-art console access.

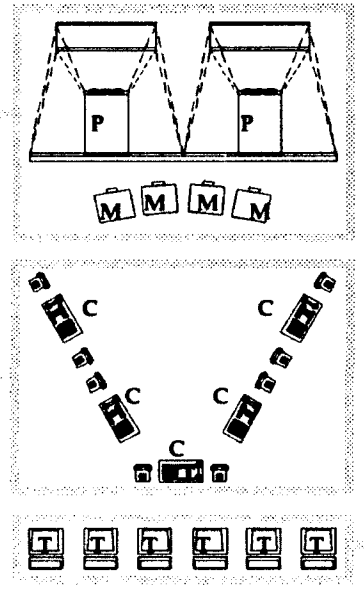
Briefing and Display Subsystem Requirements:
1. Large-screen projection units, either rear-screen units in an adjacent room or self-contained units within the space.
2. Additional TV monitors as required for supplemental displays (CNN, JVIDS, etc.)
3. Audio amplification system with interconnection to other watch and briefing spaces.
4. Display control console, internal or in an adjacent space for local selection of display images.

P= rear screen projector with mirror

M= LSD monitor

Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.
4. Access to multi-dimensional message service, including electronic mail and file transfers.
5. Access to internal and external facsimile connections that have multi-level-security.

C = communications handset



Information Processing Subsystem Requirements:
1. Access to a multi-dimensional information processing system that includes:
a. automated message handling system (AMHS)
b. multi-media management and storage system
c. text archival/retrieval system
d. mapping system
e. multi-level security (MLS) gateways
f. distributed processing and heterogenous platform connectivity
2. Computer terminals, connected to all relevant command watch teams, e.g., CSS, Intel, Ops, Logistics, etc.

T = computer terminal

• **Convenient local control of LSD images:**
1. Individual keypad or touchscreen local controller to simplify image selection.
2. Local selection of images may be by controller located on podium, however an alternative method of image selection is advisable when briefers do not wish to control images.
3. Requested images should be displayed in acceptable real time of typically 2 to 5 seconds.

• **Provide optimal LAN connectivity between the command watch teams:**
1. Structure the LAN topology as "communities -of-interest" group LANs (e.g., CAT space, LCC space, Intel Center space that all have common interface during a crisis event).
2. Limit LAN briefing area applications to those that support command decision-making (e.g., JVIDS, mapping, message handling, database management).

• **Adequate size and quality of LSD images based on distance to primary viewers:**
1. Up to three large screen displays, with screen sizes 6 to 8 feet wide.
2. CRT LSD projectors offer highest performance/price tradeoff. For 6 to 8 foot wide displays, projectors employing 7 or 8 inch CRTs will provide adequate displays in a medium-to-low light level room. If rear-screen projection is not possible, consider self-contained projection units.)
3. Digital convergence projectors should be selected.

• **Adequate size and quality of LS monitors based on distance to primary viewers:**
1. Three to five multiple large screen displays with image sizes between 30 inches (diagonal) and 67 inches (diagonal). For high-scan rate displays, consideration may be given to using 48 or 67 inch (diagonal) self-contained projectors.
2. Large-screen monitors are available that provide display sizes from 30 inches (diagonal) to 37 inches (diagonal). Monitor selection is dependent upon video source signals to be displayed. Large video monitors are generally limited to 15 to 36 kilohertz horizontal scan rates. Scan converters may be necessary.
3. Individual monitor speakers or a single switchable speaker may be employed for television audio. A third alternative is to route television signals to one display only with audio following video to a dedicated speaker. Adjustment of speaker volume should be accessible at the podium and the conference table.

guidance/facility component systems

• Space located so the personnel can securely and efficiently interact with others -- especially during crisis events:
1. This functional space should be located within the core of a command center. The desired location is adjacent to or near the Crisis Action Team space.
2. Typical crisis event activities require that this functional space be located within a SCIF.

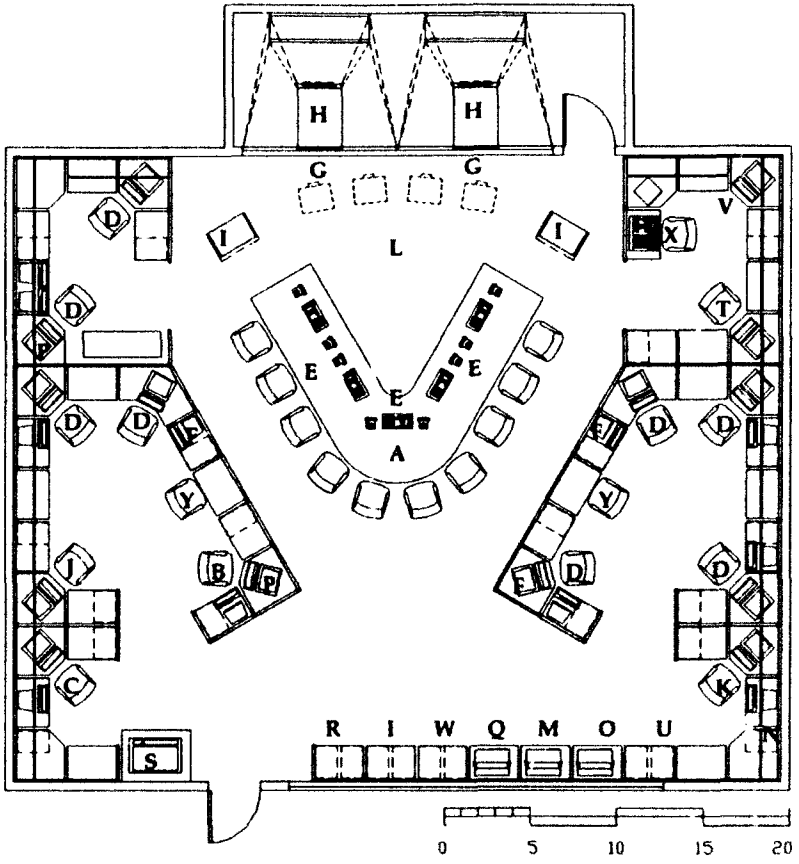
• Acceptable travel distance within the space to the nearest door during a fire:
1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)
2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.

• Acceptable travel distance to the nearest building exit during a fire:
1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)

• Effective relationship of lead personnel to staff:
1. Locate the senior person(s) at the center of the operational workstations -- with a maximum of 20 to 25 feet from the farthest workstations (and/or display screens).

Provide a U-shaped conference table configuration that allows optimum seating arrangements for both face-to-face discussions and viewing of automated briefing displays.

• Optimal choice for the rearrangement of personnel workstation modules:
1. To maintain a responsive, efficient work environment, space management should be localized with the first supervisors. Local planning and management are needed to retain equitable space allocation, to maintain previously established standards, and to respond efficiently to changing situations.



Equipment List

A. Main DAT console/DAT chief workstation:
- WWMCCS terminal and side printer
- Communications support
- Full visual display control panel

B. Executive officer workstation:
- terminal
- applicable communications support

C. NCO administration workstation:
- Automated message handling system (AMHS)
- Applicable communications support

D. DAT team deployment management station:
- Communications support
- Computer/information database links.

E. Full communications support:
- Commercial
- Autosevocom
- Red switch
- PA system/intercom
- Autovon

F. Link with applicable information databases
G. Maps, charts, and displays
H. Rear-screen projection system (1-2 screens)
I. Lectern with display controls
J. NCOIC workstation:
- Worksurface with storage
- Bookshelves/file cabinet(s)
- Ergonomic chair(s)

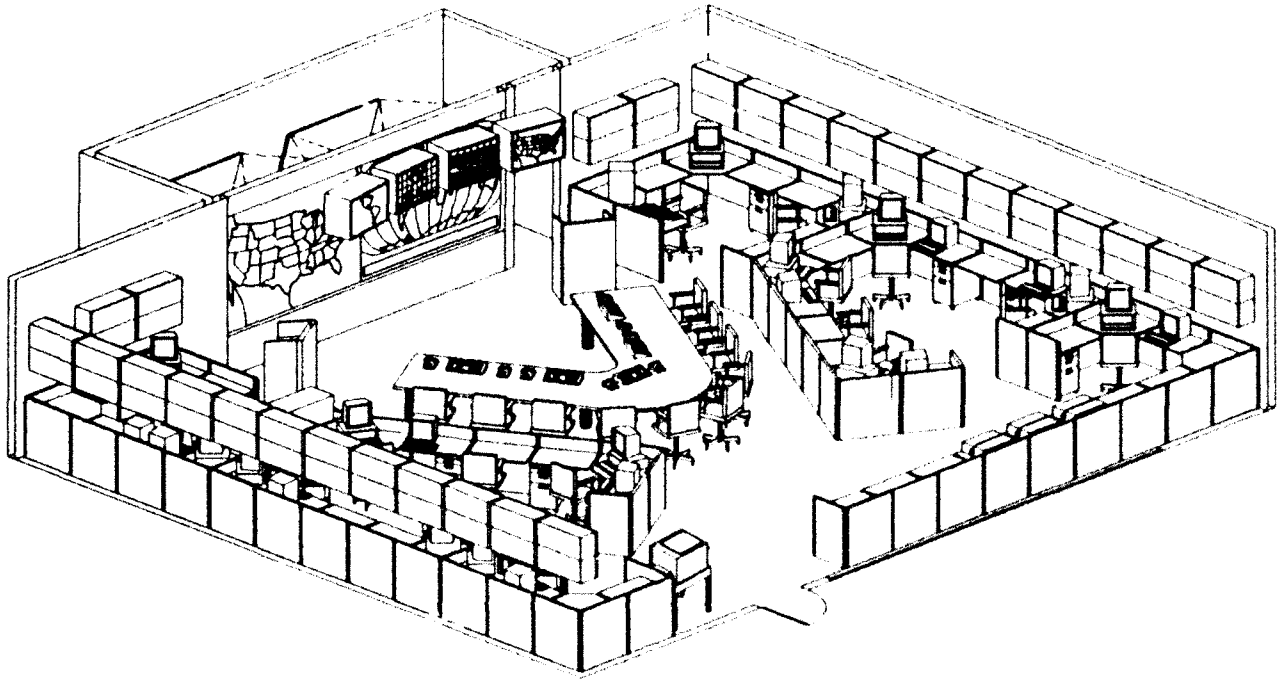
K. Typist workstation:
- Worksurface with storage
- Machine surface
- Printer with stand
- Supply storage
- Ergonomic chair(s)

L. TV monitors
M. Terminal(s)/printer(s)
N. Word processor
O. AMHS
P. WIN terminal
Q. MOD-40 teletype
R. General DAC supplies storage
S. Copier(s)
T. Chief's workstation:
- Worksurface with storage
- Bookshelves/file cabinet(s)
- Terminal and printer
- Ergonomic chair(s)

U. Honeywell 7705(s) with printer(s)
V. WISCUS workstation
W. RLP
X. Briefing support workstation:
- Console with control of visual display devices
- Applicable communications support
- Lighting controls
- Ergonomic chair

Y. Observation workstation:
- Shared worksurface or worktable
- Communications support
- Ergonomic chair(s)

guidance/facility component systems



• Ability to view projected graphics while simultaneously performing normal work tasks:
1. Ceiling ambient light fixtures (usually fluorescent) in rooms having large projection screens should be in "bank-switched" rows, with the row directly in front of the screens having non-reflective louvers so that no ambient light will wash out the projected image.
2. Flexible task light fixtures should be provided at all individual office-type workstations where AO continue normal work tasks during presentations.

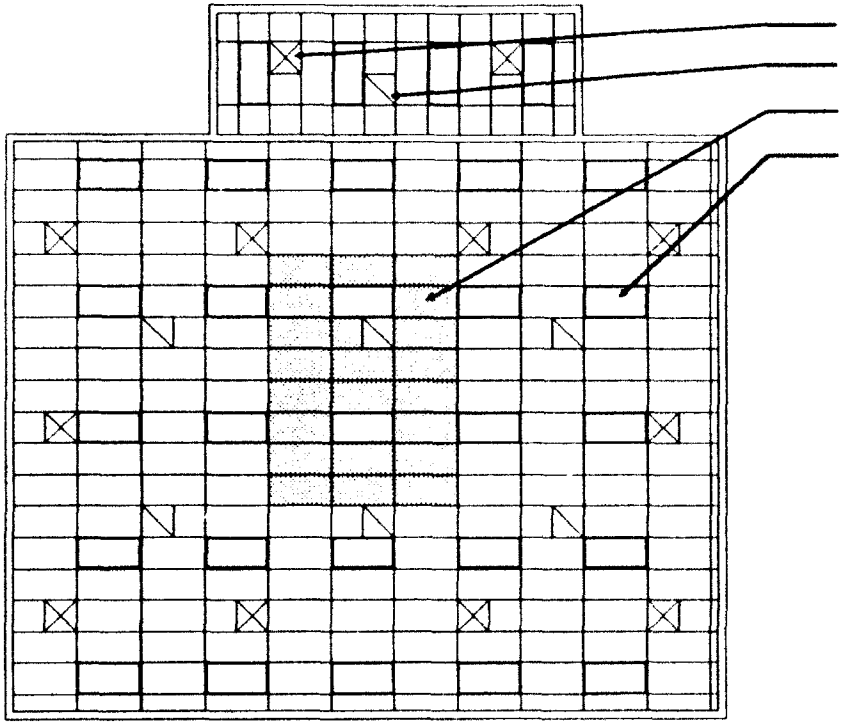
• Workstation component and seating adjustability for effective ergonomic interaction:
1. Seating for virtually all positions, clerical, computer operator, technician, and supervisory, should be of the type that is adjustable to a range of tasks and individual needs. Adjustments should include seat height, backrest height, seat pan tilt, and backrest angle.
2. Machine and computer keyboard surfaces are especially important in terms of adjustability -- height, slope, and angle. Video display terminals must be placed at the proper viewing height and angle, along with being adjustable for individual operator needs. Worksurfaces must be located at the proper height for the specified task and be adjustable to suit individual occupant requirements. Suggested surface heights include:
a. working/writing surface: 26"-31".
b. machine interaction surface: 24"-27".
c. computer keyboard surface: 24"-30".

• Adequate brightness of projected graphics:
A rear-screen projector with a minimum output of 1000 lumens is recommended for an approximately eight-foot-wide image. Reducing the screen width to approximately six feet permits the use of projectors with a brightness of 600 lumens. WARNING: Large-screen projector images of highly detailed graphics may have limited legibility no matter how bright they are.

• Coordination of graphic presentations by briefers:
The briefers' lectern should contain the necessary communication connectivity to control the automated presentations and/or the necessary communication connection to those who do manual presentations. Such controls must be simple and obvious, since the briefers must primarily concentrate on text. (Ambient lighting controls should be on the room walls adjacent to the lectern rather than being on the lectern itself.)

• Adequate personnel workstation area and appropriate workstation locations:
1. Provide the action officer (AO) workstation furniture as a continuous counter without any kneehole constraints. This allows for:
a. maximum amount of desk-type worksurface area available.
b. maximum choice of where AO and equipment can be located and/or co-located, especially when additional AOs are required to augment the assigned personnel for short time periods.
2. Provide the AO system furniture workstations using a standard 36" module throughout. This allows for:
a. easy rearrangement of all components since they will all always be compatible with each other.
b. easy removal of individual desk unit components to accommodate floor-mounted equipment, and then the possible replacement of desk units when the equipment is eventually developed as desktop models.

guidance/facility component systems



REFLECTED CEILING PLAN

• Minimize reflected glare on VDT screens:
1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

• Enable easy ceiling light fixture changes:
1. It is intended that there will be periodic changes in the location of personnel workstations. The ceiling fluorescent light fixtures must be installed in a manner to allow for any fixture unit to be moved to an adjacent ceiling grid module in any direction.

• Optimal acoustic conditions during high activity periods:
1. In order to provide the best working environment within operations spaces that can accommodate up to 30 or 40 persons at one time, it is suggested that the ceiling surface and available wall surface, where practical, be treated with sound-absorbing material. This treatment will allow for the maximum control of within-room noise levels.

• Impact of HVAC system noises on acoustical conditions:
Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.

• Optimal building mechanical system for equipment protection:
1. An independent air distribution system for electronic equipment spaces is needed.
2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.
3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall be used in electronic equipment cabinets.
4. Duct fire dampers shall be used in ducts that penetrate two-hour fire resistance-rated walls, partitions, shafts.

• HVAC mechanical system to adequately accommodate electronic-generated heat loads:
1. Heat dissipation by computers, radios, and other electronic equipment is relatively constant; therefore, cooling is required year-round. The room sensible-heat ratio is near unity because heat generated by the computer system is all sensible.
2. The number of required air changes per hour should be 10 to 20 because of the equipment's high heat generation.
3. Humidity control is required year-round to maintain necessary conditions. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components.

• Room acoustic conditions determined by audio system designs:
1. For meeting-type rooms a successful microphone/speaker system depends upon the surface treatment in the room itself. Both the floor and walls should be covered with sound-absorbing materials. The ceiling surface, however, should be reflective over the conference table area and over the observer seating areas.

Policy/SOP

The operations room of the Reconnaissance Center will operate continuously during both day-to-day and crisis situations. Because of the sensitive nature of the information and material being used within portions of the Reconnaissance Center, those portions shall be physically secured and have controlled personnel entry. The systems for the retrieval and display of applicable information shall be periodically maintained, tested, and in a constant state of readiness, should they be required during a crisis situation.

C17
RECONNAISSANCE CENTER

ADMINISTRATIVE AREA

function

For the single-source direction and monitoring of all reconnaissance resources and reporting of force status in support of the command center decision-making process.

Space Subfunctions:

1h. Direct and task surveillance systems.

4j. Perform sortie timing, routing, and target assessment; perform reconnaissance planning.
m. Present plans to decision-makers.

8h. Provide reconnaissance information for damage assessment.
i. Provide bomb damage information, and weapon strike data; assess U.S., Allied, and enemy operations and strike results.
j. Provide nuclear detonation information.
k. Perform attack, strike, damage, and residual capability assessment; estimate remaining operational capability.

operations

1. Provide reconnaissance support to a command center.
2. Provide reporting capability of forces' status information.
3. Provide monitoring of any reconnaissance mission within the center's area of responsibility.
4. Provide reconnaissance briefings as required.
5. Provide visual aids and displays as necessary to support briefing information and the decision-making process.

Staff functions and responsibilities for the operation of this space	Primary responsibility for:	Receives input from:	Provides input to:	Performs at:
Personnel				
Intelligence		●	●	●
Operations	●	●	●	●
Logistics		●		●
Plans				
Comm.-Electronics		●		

activities

1. Direct/supervise the Reconnaissance Center activities.
2. Prepare plans and schedules for reconnaissance activities.
3. Receive visitors.
4. Provide support for the Reconnaissance Center.

personnel

- Chief
- 1 assistant chief
- 2-4 plans/program personnel
- 1 secretary/receptionist
- 2 clerical support

equipment

- Chief's office:
  - Worksurface with storage
  - File cabinets
  - Ergonomic chair
  - Bookcases
  - 8 visitor's chairs
  - Conference table
  - Whiteboard/display surface
- Assistant chief's Office:
  - Worksurface with storage
  - File cabinets
  - Bookcases
  - Ergonomic chair
  - 4 visitor's chairs
  - Whiteboard/display surface
- Plans/program personnel area:
  - Worksurface with storage
  - Bookcase
  - Ergonomic chair
  - 1-2 visitor's chairs
- Secretarial/reception/clerical support area:
  - Worksurface with storage
  - Machine surface
  - Supply storage
  - Ergonomic chair
- Communications support
- Link with all applicable information databases
- Display surfaces
- Word processing station
- File/reference storage
- Copy machine
- General supplies storage

RECONNAISSANCE OPERATIONS AREA

activities

1. Monitor reconnaissance missions in progress.
2. Monitor force status.
3. Respond to requests for status information.
4. Develop reconnaissance plan and schedule.
5. Maintain necessary communication and information connectivity with other sources.
6. Prepare daily reconnaissance briefings.
7. Prepare and distribute reconnaissance reports as necessary.

personnel

- Operations chief
- 1 NCIOC (per shift)
- 2-4 reconnaissance personnel (per shift)

equipment

- Operations chief workstation:
  - Worksurface with storage
  - Bookcase/file cabinets
  - Conference table
  - 4 visitor's chairs
  - Ergonomic chair
- NCO workstation:
  - Worksurface with storage
  - Bookcases
  - Ergonomic chair
- 1-2 reconnaissance watch consoles:
  - These 2-person consoles contain the necessary information and communications systems to support the reconnaissance mission
- Action officer briefing console
- Full communications support
  - Autovon
  - Intercom
  - Commercial
  - PA system
  - Red switch
- Maps, charts, whiteboard
- Storage for maps and charts
- Classified material containers
- Link with all applicable databases
- TV monitors
- World clocks

rev. Sept. '91

GRAPHICS SUPPORT AREA

activities

1. Receive information to be presented.
2. Determine optimum method for presentation.
3. Prepare visual aid.
4. Reproduce aid as required.
5. Distribute aid.

NOTE: The Graphics Support Area of the Reconaissance Center supports only the immediate needs required by the center. Larger or more complex graphics tasks are handled by a command center Graphics Production Area (see space S13).

personnel

- 1 graphics technician

equipment

- Graphics workstation:
  - Drafting table
  - Worksurface with storage
  - Layout table
  - Ergonomic stool
- Plan file for maps and charts
- Storage cabinet for supplies
- Communications support

CONFERENCE AREA

activities

1. Present reconnaissance information.
2. Display information.
3. Modify and display additional information as required.
4. Analyze information.
5. Form decisions as required.
6. Communicate decisions/information as necessary.

personnel

- Up to 8 seated personnel and 10 observers, as applicable

equipment

- Conference table with information display terminals, communications support, and information display controls.
- Seating for 10
- Observer seating for 5 to 7
- Whiteboard/display surface
- Briefing position with information display and room illumination controls
- Link with all applicable databases
- World clocks

requirements	criteria	commentary
1. Enough space to accommodate the personnel, activities, and equipment associated with the Reconnaissance Center function.	1. Space shall be provided for the scheduling and monitoring of reconnaissance missions in support of day-to-day or crisis operations. The space may be divided or subdivided into additional areas as required by the organizational structure of the specific command center. Space has been apportioned into four general areas, as follows: Operations Area 800 sq. ft. Administration Area 1200 sq. ft. Conference Room 300 sq. ft. Graphics Support 125 sq. ft.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. A secure environment for the monitoring of sensitive/critical information during crisis and non-crisis situations.	2. The Reconnaissance Center shall be located within the facility so that discussion and presentation of sensitive material in the space cannot be compromised. The access to the space must be controlled so no one may enter without proper clearance. All appropriate equipment in the space must be TEMPEST certified.	2.  See TEMPEST section of the Security Systems in CCDH Volume 3 (page 7-33).
3. Interior finishes suitable for durability, maintenance, and room function.	3. ***Floors*** Anti-static carpet in roll goods or tiles over hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	3.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
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guidance/mission support systems for communication, information processing, and briefing and display

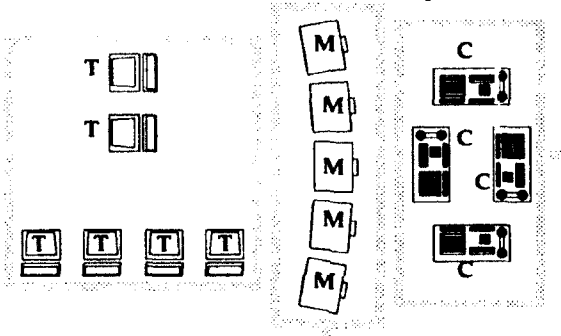
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1. Three to five multiple large screen displays with image sizes between 30 inches (diagonal) and 67 inches (diagonal). For high-scan rate displays, consideration may be given to using 48 or 67 inch (diagonal) self-contained projectors.
2. Large-screen monitors are available that provide display sizes from 30 inches (diagonal) to 37 inches (diagonal). Monitor selection is dependent upon video source signals to be displayed. Large video monitors are generally limited to 15 to 36 kilohertz horizontal scan rates. Scan converters may be necessary.
3. Individual monitor speakers or a single switchable speaker may be employed for television audio. A third alternative is to route television signals to one display only with audio following video to a dedicated speaker. Adjustment of speaker volume should be accessible at the podium and the conference table.

Information Processing Subsystem Requirements:
1. Access to a multi-dimensional information processing system that includes:
a. automated message handling system (AMHS)
b. multi-media management and storage system
c. text archival/retrieval system
d. mapping system
e. multi-level security (MLS) gateways
f. distributed processing and heterogenous platform connectivity
2. Computer terminals, connected to all relevant command watch teams, e.g., CSS, Intel, Ops, Logistics, etc.

T = computer terminal

• Provide optimal LAN connectivity between the command watch teams:
1. Structure the LAN topology as "communities -of-interest" group LANs (e.g., CAT space, LCC space, Intel Center space that all have common interface during a crisis event).
2. Limit LAN briefing area applications to those that support command decision-making (e.g., JVIDS, mapping, message handling, database management).

• Optimum interoperability of the LAN:
1. In order to take advantage of the IPS currently available, the commands' LAN system will require a UNIX-based platform, and should be compliant with GOSIP, X Window, and Motif standards.
2. AO's connected to the command LAN require terminals similar to UNIX-based integrated workstations.
3. In order to support operations, the LAN requires several laser printers with a minimum of 2 MB of random access memory (RAM).



Briefing and Display Subsystem Requirements:
1. Display control console, internal or in an adjacent space for local selection of display images.
2. Video monitors of adequate number and size that will accept all required image signals.
3. Large flat-panel alphanumeric displays, employing plasma technology, to be use to provide general message information.

M= LSD monitor

• Minimize numbers of handsets required:
1. Use red/black interface phones to eliminate the need for multiple handsets.
2. Provide phone handsets with user-friendly single/multiple channel control buttons and with a "message window" that indicates the classification level of the call connection.

• Adequate communication switching capacity:
1. The internal and external communication connectivity needs to be optimal during peak crisis periods. Lead team personnel should have state-of-the-art console access.

• Adequate facsimile capability:
1. Provide both non-secure and secure facsimile machines with at least one spare machine available at each level.
2. Tie in the FAX capability with the LAN system to take advantage of LAN scanner, printers, etc.

Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.
4. Access to multi-dimensional message service, including electronic mail and file transfers.
5. Access to internal and external facsimile connections that have multi-level-security.

C = communications handset

• Adequate numbers and quality of the secure/nonsecure telephone units:
1. Calls to the telephones of key local and distant individuals are established within 10 seconds or less.
2. Voice clarity over all communication paths is equivalent to STU-111 clarity or better.
3. Provide "precedence" capability to assure the most important C3 messages get through first.

• Convenient local control of LSD images:
1. Individual keypad or touchscreen local controller to simplify image selection.
2. Local selection of images may be by controller located on podium, however an alternative method of image selection is advisable when briefers do not wish to control images.
. . Requested images should be displayed in acceptable real time of typically 2 to 5 seconds.

guidance/facility component systems

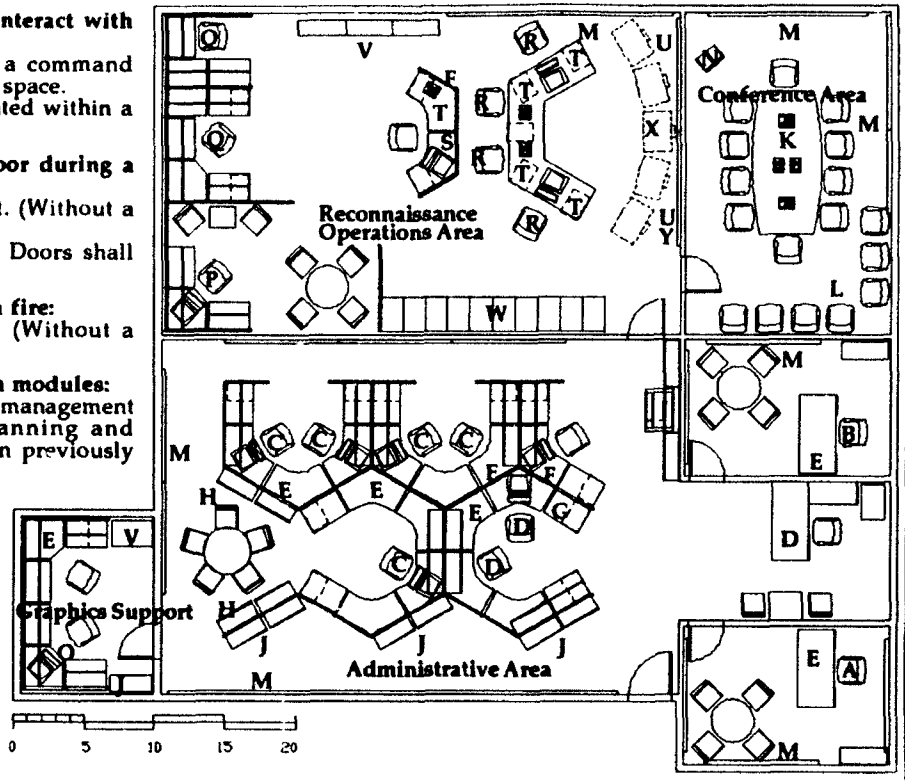
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• Optimal individual choice for the extent and location of the componentry in personnel workstation modules:
1. Provide personnel workstations using system furniture componentry with a single modular dimension of 36". This allows for:
a. easy rearrangement of all components since they will always be compatible with each other.
b. easy removal of individual desk unit components to accommodate floor-mounted equipment, and then the possible replacement of desk units when the equipment is eventually developed as desktop models. Personnel workstations using system furniture 36" components can be configured as either rectangular or hexagonal modules. The hexagonal modules are recommended for this space.



Equipment List

A. Chief's office:
- Worksurface with storage
- Bookshelves/file cabinet(s)
- Conference table(s)
- Whiteboard/display surface
- 5 visitor's chairs

B. Asst. chief's office:
- Worksurface with storage
- Bookshelves(s)/file cabinet(s)
- Ergonomic chair(s)
- Whiteboard/display surface
- 4 visitor's chairs

C. Plans/Program Personnel:
- Worksurface with storage
- Bookshelves/file cabinet(s)
- Ergonomic chair(s)
- 1-2 visitor's chairs

D. Secretarial/Reception/ Clerical Support
- Worksurface with storage
- Ergonomic chair(s)
- Machine surface
- Supply storage

E. Communications support
F. Link with applicable information databases
G. Word processing station
H. File/reference storage
I. Copier(s)
J. General supplies storage
K. Conference table with information display terminals, communications support, and information display controls. Seating for 10.
L. Observer seating for 5 to 7
M. Whiteboard/display surface
N. Briefing position with information display and room illumination controls.
O. Graphics workstation:
- Worksurface with storage
- Ergonomic chair(s)
- Drafting and layout tables

P. Operations Chief workstation:
- Worksurface with storage
- Bookshelves/file cabinet(s)
- Ergonomic chair(s)
- Conference table
- 4 visitor's chairs

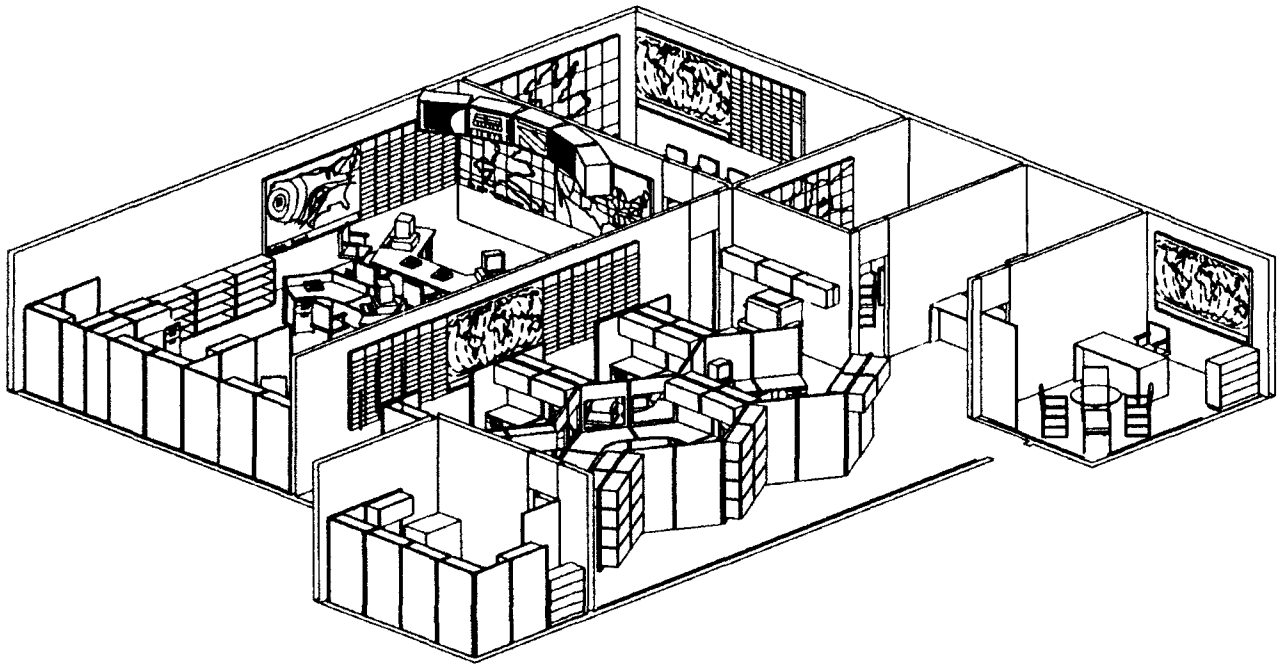
Q. NCO workstation:
- Worksurface with storage
- Bookshelves/file cabinet(s)
- Ergonomic chair(s)

R. 1-2 reconnaissance watch consoles:
- These 2-person consoles contain the necessary information and communication systems to support the reconnaissance mission.

S. Action officer briefing console
T. Full communications support
- Commercial
- Autovon
- Red switch
- PA system
- Intercom

U. Maps, charts
V. Storage for maps, charts, displays
W. Classified material container(s)
X. TV monitor
Y. World clocks

guidance/facility component systems



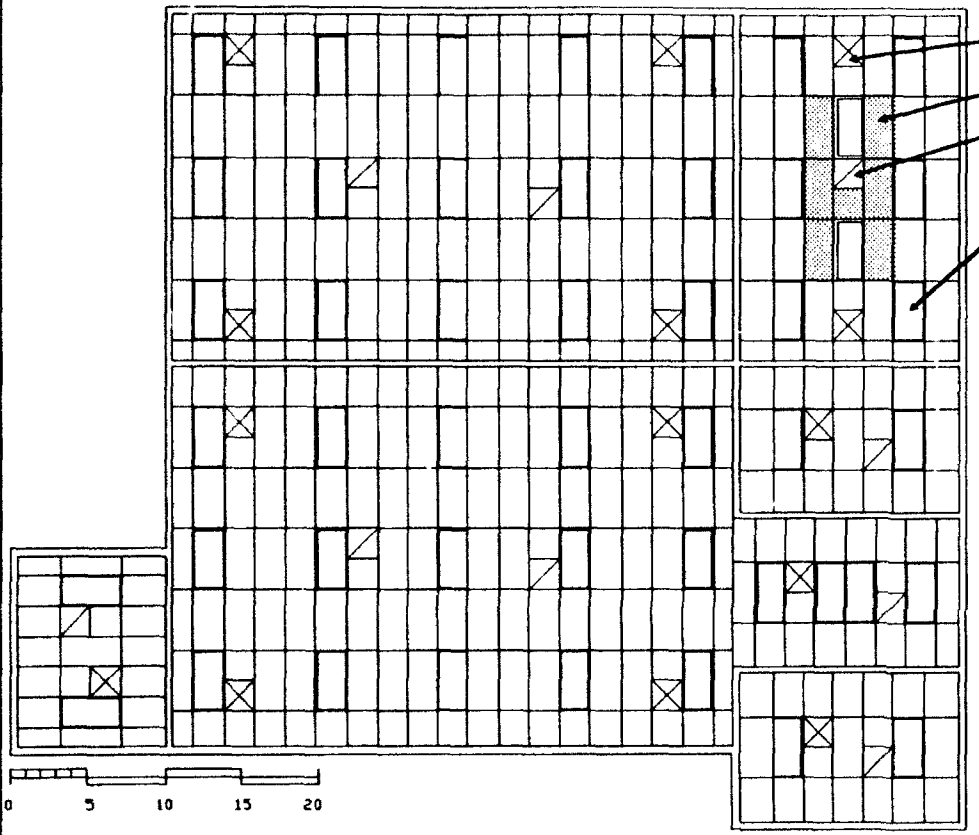
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1. Provide the action officer (AO) workstation furniture as a continuous counter without any kneehole constraints. This allows for:
a. maximum amount of desk-type worksurface area available.
b. maximum choice of where AO and equipment can be located and/or co-located, especially when additional AOs are required to augment the assigned personnel for short time periods.
2. Provide the AO system furniture workstations using a standard 36" module throughout. This allows for:
a. easy rearrangement of all components since they will all always be compatible with each other.
b. easy removal of individual desk unit components to accommodate floor-mounted equipment, and then the possible replacement of desk units when the equipment is eventually developed as desktop models.

• **Impact of HVAC system noises on acoustical conditions:**
Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.

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2. Machine and computer keyboard surfaces are especially important in terms of adjustability -- height, slope, and angle. Video display terminals must be placed at the proper viewing height and angle, along with being adjustable for individual operator needs. Worksurfaces must be located at the proper height for the specified task and be adjustable to suit individual occupant requirements. Suggested surface heights include:
a. working/writing surface: 26"-31".
b. machine interaction surface: 24"-27".
c. computer keyboard surface: 24"-30".

• **Coordination of graphic presentations by briefers:**
The briefers' lectern should contain the necessary communication connectivity to control the automated presentations and/or the necessary communication connection to those who do manual presentations. Such controls must be simple and obvious, since the briefers must primarily concentrate on text. (Ambient lighting controls should be on the room walls adjacent to the lectern rather than being on the lectern itself.)

guidance/facility component systems



REFLECTED CEILING PLAN

• **HVAC mechanical system to adequately accommodate electronic-generated heat loads:**

1. Heat dissipation by computers, radios, and other electronic equipment is relatively constant; therefore, cooling is required year-round. The room sensible-heat ratio is near unity because heat generated by the computer system is all sensible.
2. The number of required air changes per hour should be 10 to 20 because of the equipment's high heat generation.
3. Humidity control is required year-round to maintain necessary conditions. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components.

• **Optimal building mechanical system for equipment protection:**

1. An independent air distribution system for electronic equipment spaces is needed.
2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.
3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall be used in electronic equipment cabinets.
4. Duct fire dampers shall be used in ducts that penetrate two-hour fire resistance-rated walls, partitions, shafts.

• **Minimize reflected glare on VDT screens:**

1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

• **Optimal acoustic conditions during high activity periods:**

1. In order to provide the best working environment within operations spaces that can accommodate up to 30 or 40 persons at one time, it is suggested that the ceiling surface and available wall surface, where practical, be treated with sound-absorbing material. This treatment will allow for the maximum control of within-room noise levels.

• **Enable easy ceiling light fixture changes:**

1. It is intended that there will be periodic changes in the location of personnel workstations. The ceiling fluorescent light fixtures must be installed in a manner to allow for any fixture unit to be moved to an adjacent ceiling grid module in any direction.

Note:

The operations of the Nuclear Warfare Status Center will typically dictate that there be more than one space involved. The way in which these spaces are created or functions grouped within them will depend upon the individual command center mission. For the purpose of this document, spaces will be listed *individually* with relation to the activities, personnel, and equipment, and will be grouped with similar spaces in terms of the requirements, criteria, and commentary information. Guidance information, however, will be given for the entire Nuclear Warfare Status Center as a whole.

C18
NUCLEAR WARFARE STATUS CENTER

function

For the maintenance, collection, analysis, and development of information for presentation and briefing to applicable operations personnel and in direct support of the Current Actions Center activities.

Space Subfunctions:

1g. Identify nuclear detonations.
h. Direct and task surveillance systems.

8a. Monitor and display U.S. military operations and mission results; receive, correlate, and maintain mission operations information.
b. Monitor the deployment of forces and material; monitor shipment status.
j. Provide nuclear detonation information.

9a. Assess termination options, conditions, and proposals.
b. Determine implications of termination.
c. Assess feasibility of termination; determine degree to which objectives have been achieved.

operations

1. Maintains and provides the necessary information required to advise the OSD (office of the Secretary of Defense) on the execution of the SIOP.
2. Provide a daily summary of SIOP forces.
3. Provide summary data to the Director of Operations as required.
4. Provide all SIOP related briefings.
5. Provide self-contained graphic production capability.
6. Provide communication and data links with all appropriate information systems.

Staff functions and responsibilities for the operation of this space	Primary responsibility for:	Receives input from:	Provides input to:	Performs at:
Personnel				
Intelligence		•	•	•
Operations	•	•	•	•
Logistics				
Plans				
Comm.-Electronics		•	•	

NUCLEAR WARFARE STATUS CENTER REMOTE JOB ENTRY ROOM:

activities

1. Provide ADP support to the SIOP function.
2. Maintain the SIOP database.

personnel

- Remote job entry computer operator(s)

equipment

- RJE computer
- RJE operator's console
- Telephone/intercom
- World clocks

NUCLEAR WARFARE STATUS CENTER GRAPHICS PRODUCTION AREA:

activities

1. Receive information to be displayed.
2. Develop concept for the graphic.
3. Select the best medium for the graphic.
4. Produce the graphic.
5. Maintain complete stock of supplies and equipment necessary for production.

personnel

- 1-2 graphic technicians

equipment

- Graphics technician workstations:
  - Drafting table
  - Layout table
  - Supply storage
  - Drafting chair
- Optional computer graphics workstation:
  - Terminal
  - Digitizer
  - Disk drive
  - Storage
  - Printer/plotter
- Light table(s)
- Copiers
- Diazo ammonia developer
- Varitype headliner
- Storage/filing cabinets
- Copy cameras
- Layout areas
- Plotter

NUCLEAR WARFARE STATUS CENTER SIOP OFFICE:

activities

1. Monitor status of SIOP committed forces.
2. Receive information.
3. Record significant changes in status.
4. Prepare SIOP information summaries.
5. Provide briefings to operations personnel.

personnel

- SIOP officer

equipment

- SIOP officer workstation:
  - Worksurface with storage
  - *File cabinet*
  - Ergonomic chair
- Conference table
- Seating for 4-6
- Bookcases
- Classified material containers
- Phones/intercom
- Whiteboard

NUCLEAR WARFARE STATUS CENTER DATA SECTION:

activities

1. Receive SIOP data.
2. Compile SIOP data.
3. Maintain SIOP database.
4. Provide data links with other appropriate command center elements.

personnel

- 4-6 technicians

equipment

- Data tecnnician workstation:
  - Worksurface with storage
  - *File cabinet*
  - Ergonomic chair
- Layout reference table
- Whiteboard
- Telephones/intercom
- Storage cabinets
- Bookcases
- Classified material containers

OPERATIONS SECTION:

activities

1. Monitor nuclear capability.
2. Monitor status of SIOP committed forces.
3. Receive information.
4. Analyze information.
5. Prepare briefings and presentations.
6. Disseminate information.

personnel

- 1 officer in charge
- 2-4 action officers

equipment

- OIC workstation:
  - Worksurface with storage
  - *Ergonomic chair*
  - Visitor's chair
  - *File cabinet*
- Action officer workstation:
  - Worksurface with storage
  - Ergonomic chair
  - File cabinet
- Full communications support:
  - Autovon
  - Commercial
  - Red switch
  - *Intercom*
  - PA system
- Honeywell visual information processor(VIP)
- Classified information containers
- Bookcases
- Whiteboard/display surfaces
- Data link with all required information databases
  - World clocks

ADMINISTRATION AREA:

activities

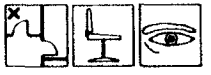
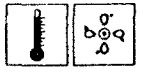
1. Direct/administer NWSC.
2. Receive visitors.
3. Provide clerical support for the office chief.
4. Store classified documents.
5. Conduct small information briefings.
6. Brief operations personnel as required.

personnel

- 1 office chief
- 1 secretary/receptionist

equipment

- Office chief workstation:
  - Worksurface with storage
  - 2 file cabinets
  - Ergonomic chair
  - Conference table
  - Seating for 6
- Clerical workstation:
  - Worksurface with storage
  - File cabinet
  - Ergonomic chair
  - Word processor
  - Typewriter
- Telephones
- Intercom
- Copier
- 2-3 visitor's chairs
- Storage area for supplies and classified material containers

requirements	criteria	commentary
1. Enough space to accommodate the equipment and personnel associated with the Nuclear Warfare Status Center function.	1. Provide space for the monitoring and reporting of current status of the nuclear-capable and SIOP committed forces. This space will typically be arranged into a series of spaces or areas, depending upon the scope of the command center mission. Space required should be in the range of: Administration 300 sq. ft. Operations Section 800 sq. ft. SIOP Office 150 sq. ft. Data Section 500 sq. ft. Graphics Production 250 sq. ft.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. A secure environment for the monitoring of sensitive/critical information during crisis and non-crisis situations.	2. The Nuclear Warfare Status Center areas shall be located within the facility so that discussion and presentation of sensitive material in the space cannot be compromised. The access to the space must be controlled so no one may enter without proper clearance. All appropriate equipment in the space must be TEMPEST certified.	2.  See TEMPEST section of the Security Systems in CCDH Volume 3 (page 7-33).
3. Interior finishes suitable for durability, maintenance, and room function.	3. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	3.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
4. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	4. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise (NC) should be between NC 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	4.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
5. Comfort features for the occupant such as chair and furniture systems comfort.	5. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	5.  See Seating section in CCDH Volume 3 (page 7-5).
6. Adequate lighting.	6. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	6.  See Interior Lighting in CCDH Volume 3 (page 7-55).
7. Adequate climate control.	7. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	7.  See HVAC section in CCDH Volume 3 (page 7-65).
8. Accessible power outlets.	8. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall. Provide a raised floor system that allows for easy access to power connections away from the walls.	8. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
9. Fire protection/life safety.	9. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	9.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

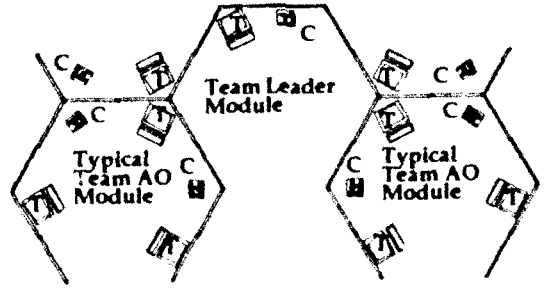
guidance/mission support systems for communication and information processing

• **Minimize numbers of handsets required**:
1. Use red/black interface phones to eliminate the need for multiple handsets.
2. Provide phone handsets with user-friendly single/multiple channel control buttons and with a "message window" that indicates the classification level of the call connection.

• **Adequate communication switching capacity**:
1. The internal and external communication connectivity needs to be optimal during peak crisis periods. Lead team personnel should have state-of-the-art console access.

Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.
4. Access to multi-dimensional message service, including electronic mail and file transfers.
5. Access to internal and external facsimile connections that have multi-level-security.

C = communications handset



• **Adequate facsimile capability**:
1. Provide both non-secure and secure facsimile machines with at least one spare machine available at each level.
2. Tie in the FAX capability with the LAN system to take advantage of LAN scanner, printers, etc.

• **Adequate numbers and quality of the secure/nonsecure telephone units:**
1. Calls to the telephones of key local and distant individuals are established within 10 seconds or less.
2. Voice clarity over all communication paths is equivalent to STU-111 clarity or better.
3. Provide "precedence" capability to assure the most important C3 messages get through first.

• **Adequate numbers and quality of computer terminals:**
1. Necessary types of information (e.g.,messages, maps, TV news) can be sent and received.
2. Undetected data errors are negligible.
3. A computer file that is needed quickly (e.g., a photo) can be delivered electronically within one minute to destinations inside the command center and within 10 minutes to remote destinations.

• **Provide optimal LAN connectivity between the command watch teams:**
1. Structure the LAN topology as "communities -of-interest" group LANs (e.g., CAT space, LCC space, Intel Center space that all have common interface during a crisis event).
2. Limit LAN briefing area applications to those that support command decision-making (e.g., JVIDS, mapping, message handling, database management).

Information Processing Subsystem Requirements:
1. Access to a multi-dimensional information processing system that includes:
a. automated message handling system (AMHS)
b. multi-media management and storage system
c. text archival/retrieval system
d. mapping system
e. multi-level security (MLS) gateways
f. distributed processing and heterogenous platform connectivity
2. Computer terminals, connected to all relevant command watch teams, e.g., CSS, Intel, Ops, Logistics, etc.

T = computer terminal

• **Optimum interoperability of the LAN**:
1. In order to take advantage of the IPS currently available, the commands' LAN system will require a UNIX-based platform, and should be compliant with GOSIP, X Window, and Motif standards.
2. AO's connected to the command LAN require terminals similar to UNIX-based integrated workstations.
3. In order to support operations, the LAN requires several laser printers with a minimum of 2 MB of random access memory (RAM).

guidance/facility component systems

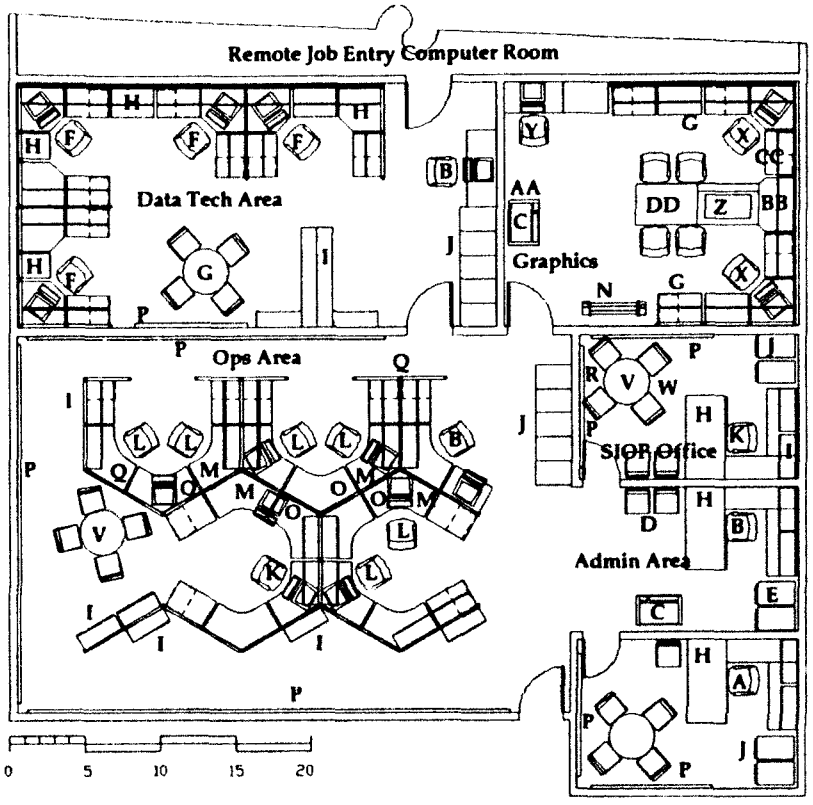
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Equipment List

A. Office chief workstation:
- Worksurface with storage
- Bookshelves/filecabinet(s)
- Ergonomic chair(s)
- Conference table
- Seating for 6

B. Clerical workstation:
- Worksurface with storage
- Bookshelves/filecabinet(s)
- Ergonomic chair(s)
- Word processor
- Typewriter

C. Copier(s)
D. 2-3 visitor's chairs
E. Storage area for supplies

F. Data technician workstation:
- Worksurface with storage
- Bookshelves/filecabinet(s)
- Ergonomic chair(s)

G. Layout/reference table
H. Telephones/intercom
I. Bookcase(s)
J. Classified material container(s)

K. OIC workstation:
- Worksurface with storage
- Bookshelves/filecabinet(s)
- Ergonomic chair(s)
- Visitor's chair

L. Action officer workstation:
- Worksurface with storage
- Bookshelves/filecabinet(s)
- Ergonomic chair(s)

M. Full communications support:
- Commercial
- Autovon
- Red switch
- PA system
- Intercom

N. Plotter
O. Honeywell visual info processor (VIP)
P. Whiteboard/display surface
Q. Link with applicable information databases
R. World clocks
S. RJE computer

T. RJE operators console

U. SIOP officer workstation:
- Worksurface with storage
- Bookshelves/filecabinet(s)
- Ergonomic chair(s)

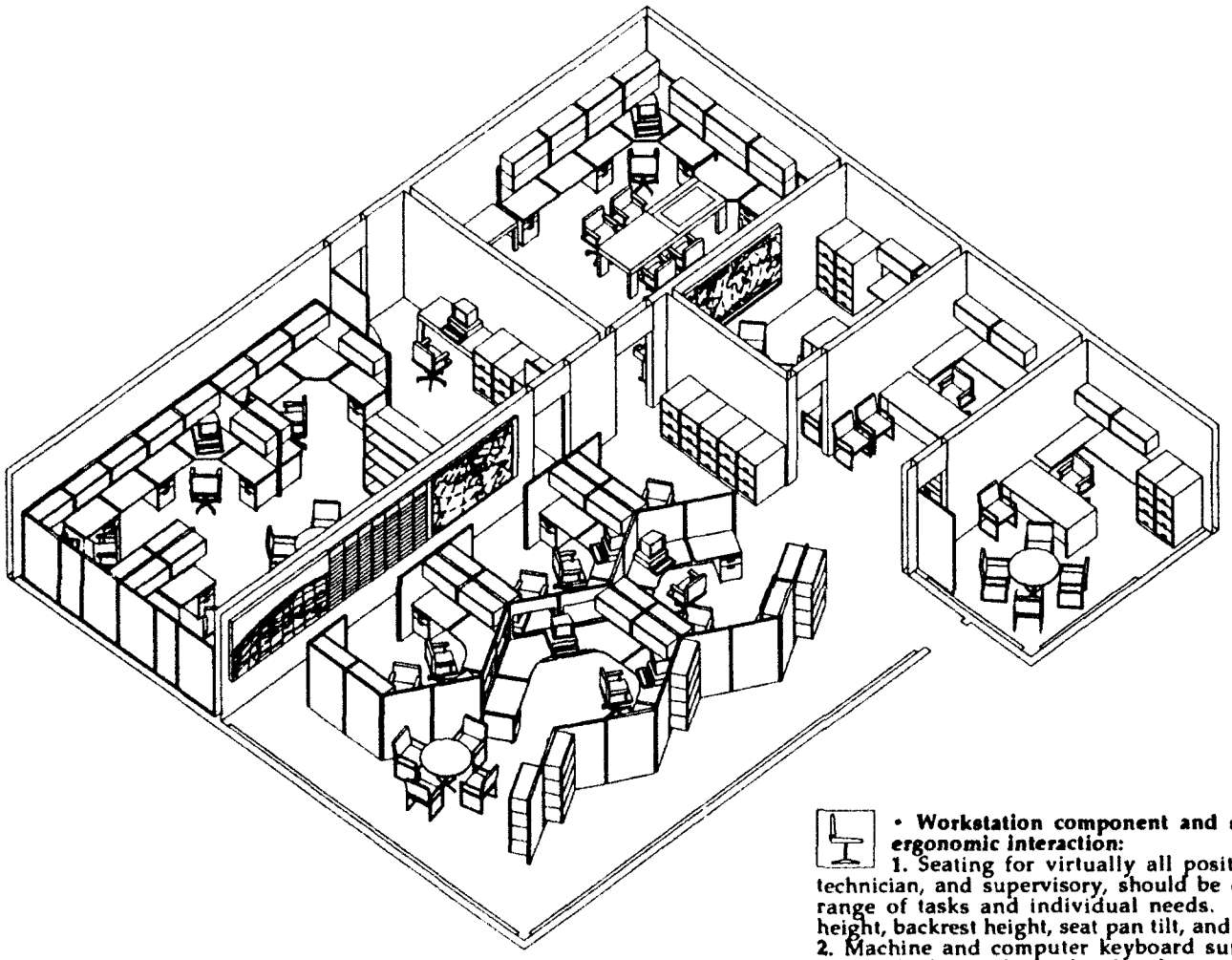
V. Conference table(s)
W. Seating for 4-6

X. Graphic Technician workstations:
- Drafting table
- Layout table
- Supply storage
- Drafting chair

Y. Optional computer graphics workstation:
- Terminal
- Digitizer
- Disk drive
- Storage
- Printer/plotter

Z. Light table(s)
AA. Diazo ammonia developer
BB. Varityper headliner
CC. Storage/filing cabinets
DD. Copy cameras

guidance/facility component systems

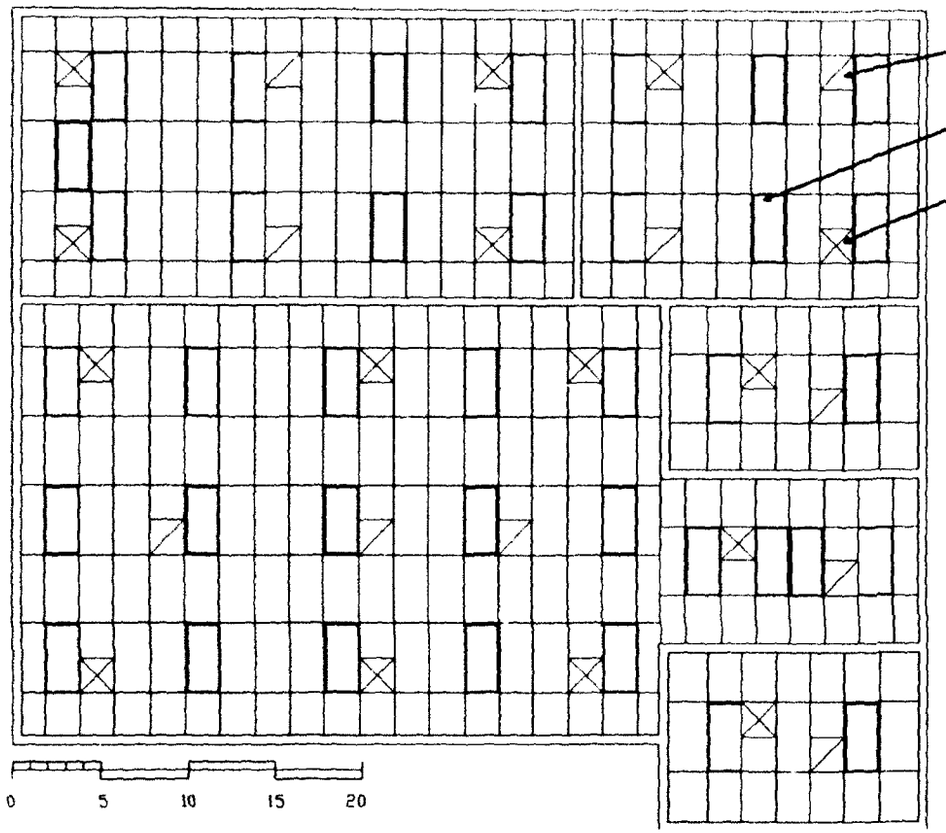


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Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.

guidance/facility component systems



REFLECTED CEILING PLAN

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4. Duct fire dampers shall be used in ducts that penetrate two-hour fire resistance-rated walls, partitions, shafts.

• **Enable easy ceiling light fixture changes:**

1. It is intended that there will be periodic changes in the location of personnel workstations. The ceiling fluorescent light fixtures must be installed in a manner to allow for any fixture unit to be moved to an adjacent ceiling grid module in any direction.

• **Optimal acoustic conditions during high activity periods:**

1. In order to provide the best working environment within operations spaces that can accommodate up to 30 or 40 persons at one time, it is suggested that the ceiling surface and available wall surface, where practical, be treated with sound-absorbing material. This treatment will allow for the maximum control of within-room noise levels.

• **Minimize reflected glare on VDT screens:**

1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

• **HVAC mechanical system to adequately accommodate electronic-generated heat loads:**

1. Heat dissipation by computers, radios, and other electronic equipment is relatively constant; therefore, cooling is required year-round. The room sensible-heat ratio is near unity because heat generated by the computer system is all sensible.
2. The number of required air changes per hour should be 10 to 20 because of the equipment's high heat generation.
3. Humidity control is required year-round to maintain necessary conditions. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components.

Policy/SOP

The Logistics Coordination Center is typically minimally staffed during non-crisis or day-to-day operations. During these times most logistics concerns will be accomplished through the established Logistics Division within the command center. During periods of crisis, manning expands to suit the requirement, and will shift to continuous operations in support of an activated Crisis Action Team. The Logistics Coordination Center supports the Crisis Action Team through the logistics representative assigned to the CAT. The Logistics Coordination Group must respond rapidly in crisis situations to assemble and provide workstations for the size of group necessary to support crisis logistics activities.

Note:

The operations of the Logistics Coordination Center will typically dictate that there be more than one space involved. The way in which these spaces are created or functions are grouped within them will depend upon the individual command center mission. For the purpose of this document, spaces will be listed individually with relation to the activities, personnel, and equipment, and will be grouped with similar spaces in terms of the requirements criteria and commentary information.

Guidance information will be given for the entire Logistics Coordination Center as a whole.

C19
LOGISTICS COORDINATION CENTER

function

For the management of logistic and mobilization actions during crisis operations and the coordination of other agencies that provide transportation and logistic support. For the ability to provide this support in a range of team structures and sizes.

Space Subfunctions:

2c. Identify critical logistic resources.

4a. Formulate operations objectives and schedule resource utilization.
b. Generate and refine force and resource requirements and options, movement requirements, resupply, and non-unit personnel requirements.
c. Merge, modify, and tailor force lists and force movement requirements to crisis operations.
d. Develop and evaluate potential courses of action (COA), including the definition of COAs and operations for situations that may require the use of US military forces. COA development is normally very time-sensitive and involves the determination of forces, logistics support, personnel, and transportation requirements to support contingencies for which no plans exist.
e. Match and select COA/OPLAN force and movement requirements with actual F/R, and allocate F/R to plans. Includes use of US and/or Allied military forces and material, and host nation support.
f. Determine and allocate F/R to special logistics requirements such as engineering, POL, ammunition, medical, and other critical areas, as applicable.
g. Perform plan analysis; determine COA/OPLAN force logistics and transportation availability and feasibility. Identify logistics, transportation, and personnel shortfalls; assess adequacy of plans to achieve objectives, considering intelligence inputs.
h. Assess projected capabilities to satisfy sustainment requirements for long-range COAs and contingency operations.
j. Perform sortie timing, routing, and target assessment; perform reconnaissance planning.
m. Present plans to decision-makers.

7f. Reconstitute and redirect forces.
g. Perform retargeting.

8b. Monitor the deployment of forces and material; monitor shipment status.
c. Provide real-time crisis management information to include force movement and logistic data.

operations

1. Provide logistics support to the Logistics Division during non-crisis or day-to-day operations.
2. Provide logistics support to the Logistics Division representative on the Crisis Action Team.
3. Provide a point of coordination for the activities of all logistics-related support agencies.
4. Provide the assemblage of personnel expertise and center capability to respond quickly and effectively to crisis situations.
5. Provide the capability to effectively communicate information and decisions relating to logistics and mobilization planning and management.

Staff functions and responsibilities for the operation of this space	Primary responsibility for:	Receives input from:	Provides input to:	Performs at:
Personnel		●		
Intelligence		●		
Operations		●	●	
Logistics	●	●	●	●
Plans		●	●	
Comm.-Electronics		●		

Staff Participation:

Review of the subfunctions and operations associated with this space suggests this mix of functional staff participation. Note that these are generic allocations of staff participation to generically stated subfunctions and operations; they should only be used as initial concept development factors.

LOGISTICS COORDINATION CENTER OPERATIONS ROOM

activities

1. Receive crisis information.
2. Analyze logistics implications.
3. Develop logistics support plans and actions.
4. Communicate plans and decisions to affected agencies as required.
5. Respond to requests from Logistics CAT Representative.
6. Provide day-to-day support to the Logistics Division.

personnel

- 1-2 action officers for day-to-day operations
- 2-15 action officers depending upon the needs generated by a specific crisis

equipment

- Action officer workstation:
  - Worksurface with storage
  - File cabinet
  - Bookshelf
  - Ergonomic chair
- 1-4 conference/work areas for 4-8 personnel
- File cabinets
- Reference area
- Classified material containers
- Display surface/whiteboard
- Full communications support:
  - Autovon
  - Commercial
  - Red Switch
  - Secure Intercom
- Link with applicable information databases
- World clocks
- Closed circuit TV

LOGISTICS COORDINATION CENTER DIRECTOR'S OFFICE

activities

1. Direct/administer LCC.
2. Receive visitors.
3. Conduct small information briefings.
4. Store classified documents.

personnel

- Director of the Logistics Coordination Center
- Deputy Director of the Logistics Coordination Center

equipment

- Director workstation:
  - Worksurface with storage
  - 2 file cabinets
  - Ergonomic chair
  - 1-2 visitor chairs
- Deputy director workstation:
- Worksurface with storage
  - File cabinet
  - Ergonomic chair
- Small conference table with seating for 4 to 6
- Telephones/intercom
- Copier
- Bookshelves
- Storage area for supplies and classified material containers

LOGISTICS COORDINATION CENTER ADP ROOM

activities

1. Provide ADP support to Logistics Division.
2. Maintain logistics planning system.
3. Maintain communication link with all logistics support information databases.

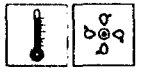
personnel

Logistics planning system computer operator(s)

equipment

- Logistics planning system computer
- System operator's console
- System user terminals
- Hard-copy terminal
- 1-2 remote line printers
- Terminal display copier
- Personnel workstations:
  - Worksurface with storage
  - File cabinets
  - Book shelf
  - Communications support
  - Ergonomic chair
- Work area with table and seating for 4-6
- Classified material containers
- Organic voice communications interface communications
- Interface communications
- WWMCCS graphics terminal/printer
- Terminal display projection

notes

requirements	criteria	commentary
1. Enough space to accommodate the equipment and personnel associated with the Logistics Coordination Center function and located within the following areas: Director's Off ce Operations Rc om	1. Provide space for the planning and management of logistics concerns relating to either the support of day-to-day activities or the direct planning and support of crisis situations. The space may be needed by the specific command center mission; however, the space provided should be within the range of: Director's Office 200 to 400 sq. ft. Operations Room 2000 to 2600 sq. ft.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. A secure environment for the monitoring of sensitive/critical information during crisis and non-crisis situations.	2. The Logistics Coordinations Center areas shall be located within the facility so that discussion and presentation of sensitive material in the space cannot be compromised. The access to the space must be controlled so no one may enter without proper clearance. All appropriate equipment in the space must be TEMPEST certified.	2.  See TEMPEST section of the Security Systems in CCDH Volume 3 (page 7-33).
3. Interior finishes suitable for durability, maintenance, and room function.	3. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	3.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
4. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	4. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise (NC) should be between NC 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	4.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
5. Comfort features for the occupant such as chair and furniture systems comfort.	5. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	5.  See Seating section in CCDH Volume 3 (page 7-5).
6. Adequate lighting.	6. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	6.  See Interior Lighting in CCDH Volume 3 (page 7-55).
7. Adequate climate control.	7. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	7.  See HVAC section in CCDH Volume 3 (page 7-65).
8. Accessible power outlets.	8. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall. Provide a raised floor system that allows for easy access to power connections away from the walls.	8. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
9. Fire protection/life safety.	9. Fire Suppression Systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	9.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

guidance/mission support systems for communication and information processing

• **Minimize numbers of handsets required**:
1. Use red/black interface phones to eliminate the need for multiple handsets.
2. Provide phone handsets with user-friendly single/multiple channel control buttons and with a "message window" that indicates the classification level of the call connection.

• **Adequate communication switching capacity**:
1. The internal and external communication connectivity needs to be optimal during peak crisis periods. Lead team personnel should have state-of-the-art console access.

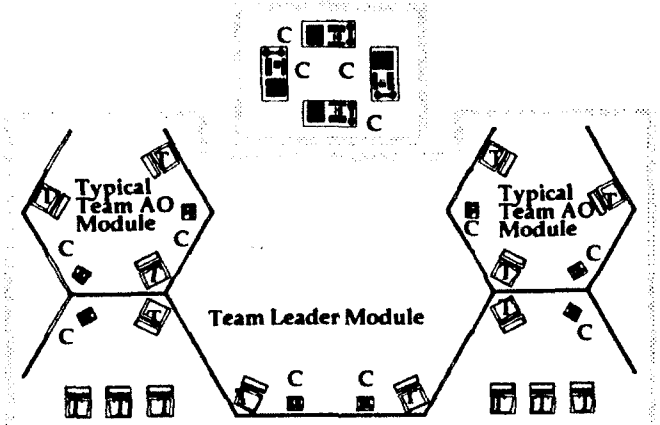
• **Adequate facsimile capability**:
1. Provide both non-secure and secure facsimile machines with at least one spare machine available at each level.
2. Tie in the FAX capability with the LAN system to take advantage of LAN scanner, printers, etc.

• **Adequate numbers and quality of the secure/nonsecure telephone units**:
1. Calls to the telephones of key local and distant individuals are established within 10 seconds or less.
2. Voice clarity over all communication paths is equivalent to STU-111 clarity or better.
3. Provide "precedence" capability to assure the most important C3 messages get through first.

• **Adequate numbers and quality of computer terminals**:
1. Necessary types of information (e.g.,messages, maps, TV news) can be sent and received.
2. Undetected data errors are negligible.
3. A computer file that is needed quickly (e.g., a photo) can be delivered electronically within one minute to destinations inside the command center and within 10 minutes to remote destinations.

Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.
4. Access to multi-dimensional message service, including electronic mail and file transfers.
5. Access to internal and external facsimile connections that have multi-level-security.

C = communications handset



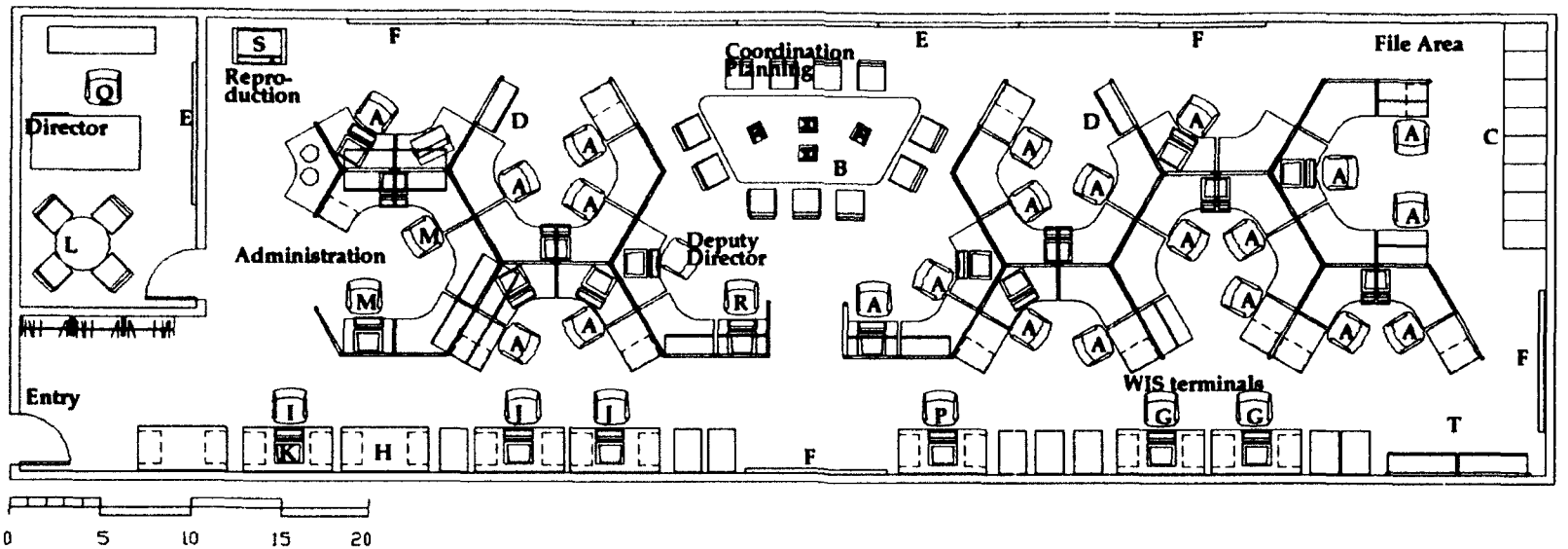
Information Processing Subsystem Requirements:
1. Access to a multi-dimensional information processing system that includes:
a. automated message handling system (AMHS)
b. multi-media management and storage system
c. text archival/retrieval system
d. mapping system
e. multi-level security (MLS) gateways
f. distributed processing and heterogenous platform connectivity
2. Computer terminals, connected to all relevant command watch teams, e.g., CSS, Intel, Ops, Logistics, etc.

T = computer terminal

• **Provide optimal LAN connectivity between the command watch teams:**
1. Structure the LAN topology as "communities -of-interest" group LANs (e.g., CAT space, LCC space, Intel Center space that all have common interface during a crisis event).
2. Limit LAN briefing area applications to those that support command decision-making (e.g., JVIDS, mapping, message handling, database management).

• **Optimum interoperability of the LAN**:
1. In order to take advantage of the IPS currently available, the commands' LAN system will require a UNIX-based platform, and should be compliant with GOSIP, X Window, and Motif standards.
2. AO's connected to the command LAN require terminals similar to UNIX-based integrated workstations.
3. In order to support operations, the LAN requires several laser printers with a minimum of 2 MB of random access memory (RAM).

guidnce/facility component systems



• Optimal individual choice for the extent and location of the componentry in personnel workstation modules:

1. Provide personnel workstations using system furniture componentry with a single modular dimension of 36". This allows for:

a. easy rearrangement of all components since they will always be compatible with each other.

b. easy removal of individual desk unit components to accommodate floor-mounted equipment, and then the possible replacement of desk units when the equipment is eventually developed as desktop models. Personnel workstations using system furniture 36" components can be configured as either rectangular or hexagonal modules. The hexagonal modules are recommended for this space.

• Space located so the personnel can securely and efficiently interact with others -- especially during crisis events:

1. This functional space should be located within the core of a command center. The desired location is adjacent to or near the Crisis Action Team space.

2. Typical crisis event activities require that this functional space be located within a SCIF.

• Acceptable travel distance within the space to the nearest door during a fire:

1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)

2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.

Equipment List

A. Action officer station:
- Worksurface with storage
- File cabinet
- Bookshelf
- Ergonomic chair

B. Conference/work area for 11 personnel
C. File cabinets
D. Reference area
E. Display surface
F. Whiteboard
G. Link with applicable information databases
H. Logistics planning system computer
I. System operator's console
J. System user terminals
K. Hard-copy terminal
L. Small conference table with seating for 4-6
M. Administration workstations:
- Worksurface with storage
- File cabinet
- Communications support
- Ergonomic chair

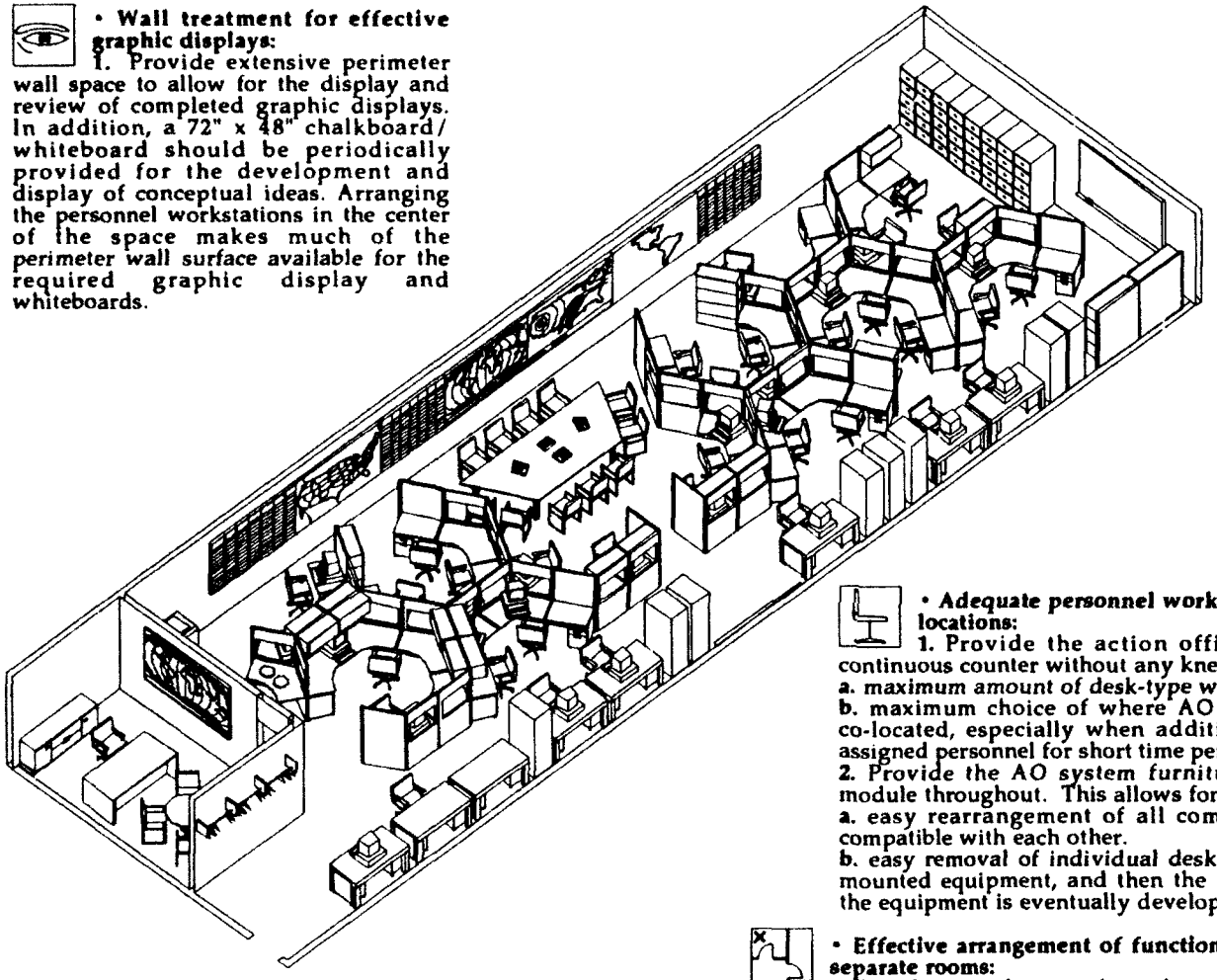
N. Classified material containers
O. Organic voice communications interface communications
P. WWMCCS graphics terminal/printer
Q. Director's workstation:
- Worksurface with storage
- File cabinets
- Ergonomic chair

R. Deputy director's station:
- Worksurface with storage
- File cabinets
- Ergonomic chair
- Bookshelf

S. Copier
T. Storage area for supplies and classified material containers

guidance/facility component systems

• **Wall treatment for effective graphic displays:**
1. Provide extensive perimeter wall space to allow for the display and review of completed graphic displays. In addition, a 72" x 48" chalkboard/whiteboard should be periodically provided for the development and display of conceptual ideas. Arranging the personnel workstations in the center of the space makes much of the perimeter wall surface available for the required graphic display and whiteboards.



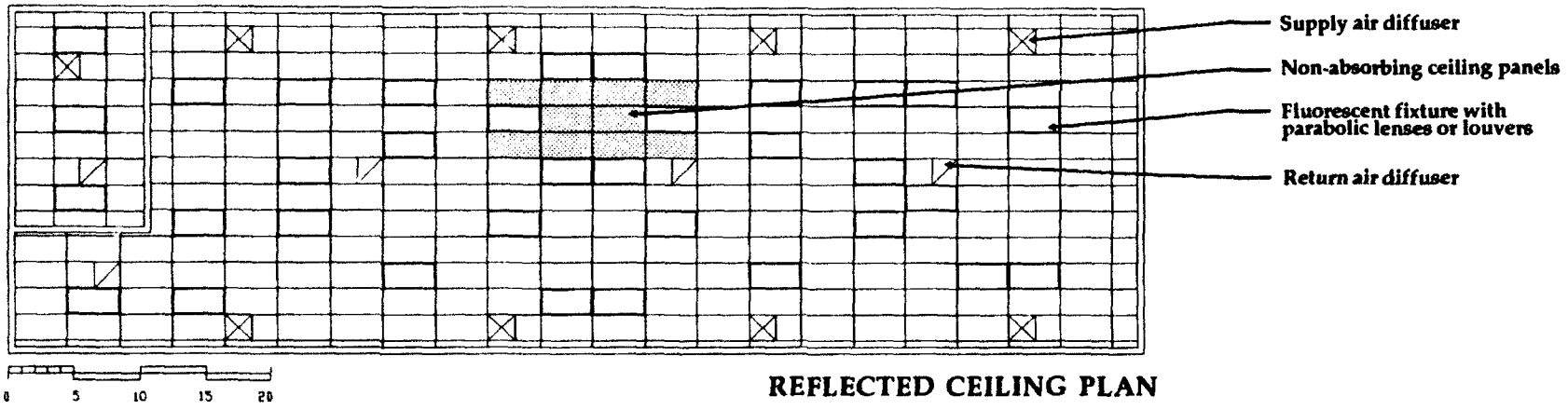
• **Workstation component and seating adjustability for effective ergonomic interaction:**
1. Seating for virtually all positions, clerical, computer operator, technician, and supervisory, should be of the type that is adjustable to a range of tasks and individual needs. Adjustments should include seat height, backrest height, seat pan tilt, and backrest angle.
2. Machine and computer keyboard surfaces are especially important in terms of adjustability -- height, slope, and angle. Video display terminals must be placed at the proper viewing height and angle, along with being adjustable for individual operator needs. Worksurfaces must be located at the proper height for the specified task and be adjustable to suit individual occupant requirements. Suggested surface heights include:
a. working/writing surface: 26"-31".
b. machine interaction surface: 24"-27".
c. computer keyboard surface: 24"-30".

• **Adequate personnel workstation area and appropriate workstation locations:**
1. Provide the action officer (AO) workstation furniture as a continuous counter without any kneehole constraints. This allows for:
a. maximum amount of desk-type worksurface area available.
b. maximum choice of where AO and equipment can be located and/or co-located, especially when additional AOs are required to augment the assigned personnel for short time periods.
2. Provide the AO system furniture workstations using a standard 36" module throughout. This allows for:
a. easy rearrangement of all components since they will all always be compatible with each other.
b. easy removal of individual desk unit components to accommodate floor-mounted equipment, and then the possible replacement of desk units when the equipment is eventually developed as desktop models.

• **Effective separation and/or interconnectivity between personnel workstations:**
1. Divider partitions between workstations should be 60 inches high (+/-4 inches) to provide visual privacy while occupants are seated and yet not be confining.
2. A number of divider partitions between workstations should be able to be opened or closed as required to allow for either direct personnel interaction when open or for visual privacy when closed. These convertible partitions are especially relevant for hexagonal workstation configurations since each module has party partitions with several adjacent modules.

• **Effective arrangement of functional spaces into either a single or several separate rooms:**
1. This functional space, depending upon the scope of the commands mission, may be arranged either in a series of spaces separated by the needs of the various activities to be housed within or as a single room. The separation which is presented in this document is neither fixed nor recommended for all situations. Each Command Center shall determine which apportionment and arrangement of spaces satisfy their particular functional needs. The example layout has all the required computer terminals co-located in the main operations space. If all the assigned personnel do not routinely have TS clearances, some terminals (WIS, etc) may need to be located in a separate, adjacent space.
2. Some commands may need to locate the "coordination/planning" activities in a separate adjacent space if the information discussed and displayed is routinely TS.

guidance/facility component systems



REFLECTED CEILING PLAN

• Minimize reflected glare on VDT screens:
1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

• Optimal acoustic conditions during high activity periods:
1. In order to provide the best working environment within operations spaces that can accommodate up to 30 or 40 persons at one time, it is suggested that the ceiling surface and available wall surface, where practical, be treated with sound-absorbing material. This treatment will allow for the maximum control of within-room noise levels.

• Impact of HVAC system noises on acoustical conditions:
Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.

• HVAC mechanical system to adequately accommodate electronic-generated heat loads:
1. Heat dissipation by computers, radios, and other electronic equipment is relatively constant; therefore, cooling is required year-round. The room sensible-heat ratio is near unity because heat generated by the computer system is all sensible.
2. The number of required air changes per hour should be 10 to 20 because of the equipment's high heat generation.
3. Humidity control is required year-round to maintain necessary conditions. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components.

• Optimal building mechanical system for equipment protection:
1. An independent air distribution system for electronic equipment spaces is needed.
2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.
3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall be used in electronic equipment cabinets.
4. Duct fire dampers shall be used in ducts that penetrate two-hour fire resistance-rated walls, partitions, shafts.

Policy/SOP

Upon activation of a Crisis Action Team (CAT), the JOPES Support Element shall operate on a continuous, 24-hour basis. During 24-hour operations, the element shall prepare requests for additional personnel and develop a 24-hour schedule for continuous staffing. All equipment shall be periodically tested and maintained to ensure 100% readiness and reliability at any time. Upon activation of the element, the appropriate outside agencies and key personnel within the command center shall be *notified* by secure means that the element is in operation. The element shall be deactivated according to established command center policy upon the termination of a Crisis Action Team. During normal day-to-day operations, the element's personnel will typically reside in the JPS space.

C20
JPS/JOPES SUPPORT ELEMENT

function

For the collection, monitoring, and analysis of all operations planning information and the timely provision of said information to the CINC and the Battle Staff in support of the decision-making process.

Space Subfunctions:

Operations planning and scheduling (deliberate and time-sensitive): Includes course of action (COA) development, force/resource allocation and movement scheduling, logistic and movement resource planning, response options and plans development, and feasibility testing in response to warning and threat assessments.

4a. Formulate operations objectives and schedule resource utilization.
b. Generate and refine forces and resources requirements and options, movement requirements, resupply, and non-unit personnel requirements.
c. Merge, modify, and tailor force lists and force movement requirements to crisis operations.
d. Develop and evaluate potential courses of action (COA), including the definition of COAs and operations for situations that may require the use of military forces. COA development is normally very time-sensitive and involves the determination of forces, logistics support, personnel, and transportation requirements to support contingencies for which no plans exist.
e. Match and select COA/OPLAN force and movement requirements with actual forces and resources, and allocate forces and resources to plans. Includes use of U.S. and/or Allied military forces and material, and host nation support.

operations

1. Provide a center for the collection and analysis of all operations planning information.
2. Provide support to the CINC and the Senior Battle Staff as required during both normal and crisis situations.
3. Provide operations planning information to the CINC and the Senior Battle Staff.
4. Provide connectivity to both national-level operations planning agencies and to the unified and specified commanders.
5. Provide a constant link with the WWMCCS system.
6. Provide a briefing information file on relevant incoming message traffic during CAT activation.
7. Provide operations planning, maps, charts, and graphics as necessary.

Staff functions and responsibilities for the operation of this space	Primary responsibility for:	Receives input from:	Provides input to:	Performs at:
Personnel		●		
Intelligence		●		
Operations	●	●	●	●
Logistics		●	●	
Plans		●	●	
Comm.-Electronics		●		

Staff Participation:

Review of the subfunctions and operations associated with this space suggests this mix of functional staff participation. Note that these are generic allocations of staff participation to generically stated subfunctions and operations; they should only be used as initial concept development factors.

JOPES PLANNING SYSTEM

activities

1. Direct/supervise all JOPES planning efforts.
2. Perform clerical support activities--filing, word processing, etc.
3. Receive visitors.
4. Hold informal briefing sessions or meetings.

personnel

- 8 action officers
- 1 secretary
- 2 data entry specialists

equipment

- 8 AO workstations:
  - Worksurface with storage
  - File cabinet
  - LAN terminal
  - Ergonomic chair
- Clerical workstation:
  - Worksurface with storage
  - Word processor
  - File cabinet
  - Ergonomic chair
- 2 Printers
- 3 Visitor's chairs with table
- Full communications support:
  - Autovon
  - Commercial
  - Red switch
  - Intercom
- Whiteboard/display surface
- Storage shelving
- Copier

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JOPES SUPPORT ELEMENT

activities

1. Operate and maintain all equipment within the element.
2. Monitor the current situation within the assigned area of responsibility.
3. Maintain connectivity with WWMCCS WIN site coordinator tasks.
4. Prepare operations planning briefing packages for analysis and briefing personnel.
5. Prepare and maintain operations situation maps and charts.
6. Maintain security of the the classified material within.

personnel

- JSE chief
- Force plans officer
- Logistics staff officer
- TDFDD analyst
- Logistics plans technician
- WIN site coordinator
- Medical plans officer
- Personnel plans officer

equipment

- 8 AO workstations:
  - Worksurface with storage
  - File cabinet
  - WISCUS terminal
- Server
- 4 printers
- 6 video monitors
- Shredder
- 2 plasma display boards (4'x8')
- Whiteboard/display surface
- World clocks
- Copier
- Storage cabinet

requirements	criteria	commentary
1. Enough space to accommodate the equipment, furnishings, and personnel associated with the JOPES Planning System and the JOPES Support Element.	1. Provide enough space to house the equipment and personnel workstations within the facility. The amount of space will depend upon the individual command center mission, staffing levels, and the area of responsibility. Typically, the support element will house 8-11 personnel, with fewer personnel being required for the evening and night shifts. For these levels the amount of space necessary would be approximately 1800 sq. ft. for the total JPS and JOPES support element.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. A secure environment for the monitoring of sensitive/critical *information during crisis and* non-crisis situations.	2. The JPS and JOPES Support Element areas shall be located within the facility so that discussion and presentation of sensitive material in the *space cannot* be compromised. The access to the space must be controlled so no one may enter without proper clearance. All appropriate equipment in the space must be TEMPEST certified.	2.  See TEMPEST section of the Security Systems in CCDH Volume 3 (page 7-33).
3. Interior finishes suitable for *durability, maintenance* and room function.	3. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, *hardened concrete.* ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	3.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
4. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	4. *Provide for a Sound Transmission* Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise (NC) should be between NC 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	4.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
5. Comfort features for the occupant such as chair and furniture systems comfort.	5. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	5.  See Seating section in CCDH Volume 3 (page 7-5).
6. Adequate lighting.	6. *Lighting shall be specially engineered.* A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	6.  See Interior Lighting in CCDH Volume 3 (page 7-55).
7. Adequate climate control.	7. Control temperature for 68°F *(heating) and* 72°F *(cooling) with a* 5 cubic foot per minute per person outside air ventilation rate.	7.  See HVAC section in CCDH Volume 3 (page 7-65).
8. Accessible power outlets.	8. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every *10 linear feet of wall. Provide a raised floor system* that allows for easy access to power connections away from the walls.	8. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
9. Fire protection/life safety.	9. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system	9.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

guidance/mission support systems

• Adequate size and quality of LS monitors based on distance to primary viewers:

1. Three to five multiple large screen displays with image sizes between 30 inches (diagonal) and 67 inches (diagonal). For high-scan rate displays, consideration may be given to using 48 or 67 inch (diagonal) self-contained projectors.
2. Large-screen monitors are available that provide display sizes from 30 inches (diagonal) to 37 inches (diagonal). Monitor selection is dependent upon video source signals to be displayed. Large video monitors are generally limited to 15 to 36 kilohertz horizontal scan rates. Scan converters may be necessary.
3. Individual monitor speakers or a single switchable speaker may be employed for television audio. A third alternative is to route television signals to one display only with audio following video to a dedicated speaker. Adjustment of speaker volume should be accessible at the podium and the conference table.

Communication Subsystem Requirements:

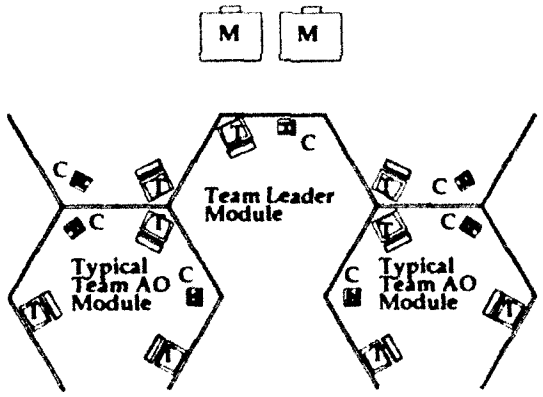
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.
4. Access to multi-dimensional message service, including electronic mail and file transfers.
5. Access to internal and external facsimile connections that have multi-level-security.

C = communications handset

Briefing and Display Subsystem Requirements:

1. Video monitors of adequate number and size that will accept all required image signals.

M = LSD monitor



Information Processing Subsystem Requirements:

1. Access to a multi-dimensional information processing system that includes:
   a. automated message handling system (AMHS)
   b. multi-media management and storage system
   c. text archival/retrieval system
   d. mapping system
   e. multi-level security (MLS) gateways
   f. distributed processing and heterogenous platform connectivity
2. Computer terminals, connected to all relevant command watch teams, e.g., CSS, Intel, Ops, Logistics, etc.

T = computer terminal

• Adequate numbers and quality of the secure/nonsecure telephone units:

1. Calls to the telephones of key local and distant individuals are established within 10 seconds or less.
2. Voice clarity over all communication paths is equivalent to STU-111 clarity or better.
3. Provide "precedence" capability to assure the most important C3 messages get through first.

• Adequate numbers and quality of computer terminals:

1. Necessary types of information (e.g.,messages, maps, TV news) can be sent and received.
2. Undetected data errors are negligible.
3. A computer file that is needed quickly (e.g., a photo) can be delivered electronically within one minute to destinations inside the command center and within 10 minutes to remote destinations.

• Provide optimal LAN connectivity between the command watch teams:

1. Structure the LAN topology as "communities -of-interest" group LANs (e.g., CAT space, LCC space, Intel Center space that all have common interface during a crisis event).
2. Limit LAN briefing area applications to those that support command decision-making (e.g., JVIDS, mapping, message handling, database management).

• Optimum interoperability of the LAN:

1. In order to take advantage of the IPS currently available, the commands' LAN system will require a UNIX-based platform, and should be compliant with GOSIP, X Window, and Motif standards.
2. AO's connected to the command LAN require terminals similar to UNIX-based integrated workstations.
3. In order to support operations, the LAN requires several laser printers with a minimum of 2 MB of random access memory (RAM).

guidance/facility component systems

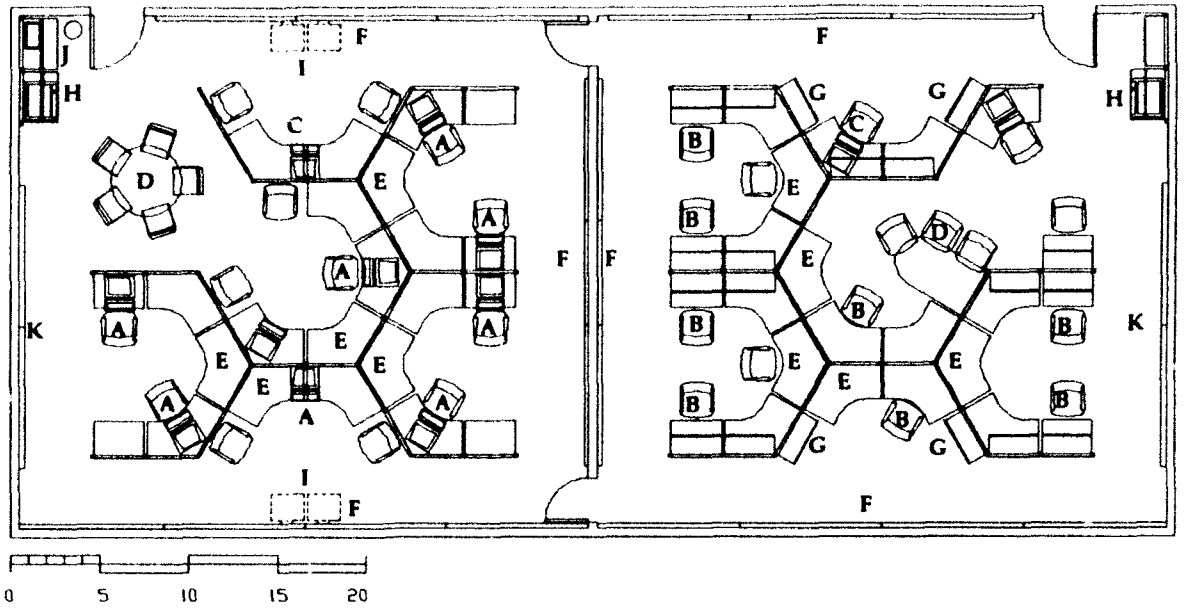
• Space located so the personnel can securely and efficiently interact with others -- especially during crisis events: This functional space should be located within the core of a command center. Desired location should be adjacent to or near the Crisis Action Team space. Typical crisis event activities require that this functional space be located within a SCIF.

• Acceptable travel distance within the space to the nearest door during a fire:

1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)
2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.

• Acceptable travel distance to the nearest building exit during a fire:

1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)



• Workstation component and seating adjustability for effective ergonomic interaction:

1. Seating for virtually all positions, clerical, computer operator, technician, and supervisory, should be of the type that is adjustable to a range of tasks and individual needs. Adjustments should include seat height, backrest height, seat pan tilt, and backrest angle.
2. Machine and computer keyboard surfaces are especially important in terms of adjustability -- height, slope, and angle. Video display terminals must be placed at the proper viewing height and angle, along with being adjustable for individual operator needs. Worksurfaces must be located at the proper height for the specified task and be adjustable to suit individual occupant requirements. Suggested surface heights include:

a. working/writing surface: 26"-31".
b. machine interaction surface: 24"-27".
c. computer keyboard surface: 24"-30".

• Optimal individual choice for the extent and location of the componentry in personnel workstation modules:

1. Provide personnel workstations using system furniture componentry with a single modular dimension of 36". This allows for:

a. easy rearrangement of all components since they will always be compatible with each other.
b. easy removal of individual desk unit components to accommodate floor-mounted equipment, and then the possible replacement of desk units when the equipment is eventually developed as desktop models. Personnel workstations using system furniture 36" components can be configured as either rectangular or hexagonal modules. The hexagonal modules are recommended for this space.

• Effective relationship of lead personnel to staff:

1. Locate the senior person(s) at the center of the operational workstations -- with a maximum of 20 to 25 feet from the farthest workstations (and/or display screens).

Equipment List

A. AO workstations:
- Worksurface with storage
- File cabinet
- WISCUS terminal

B. AO workstations:
- Worksurface with storage
- File cabinet
- LAN terminal
- Ergonomic chair

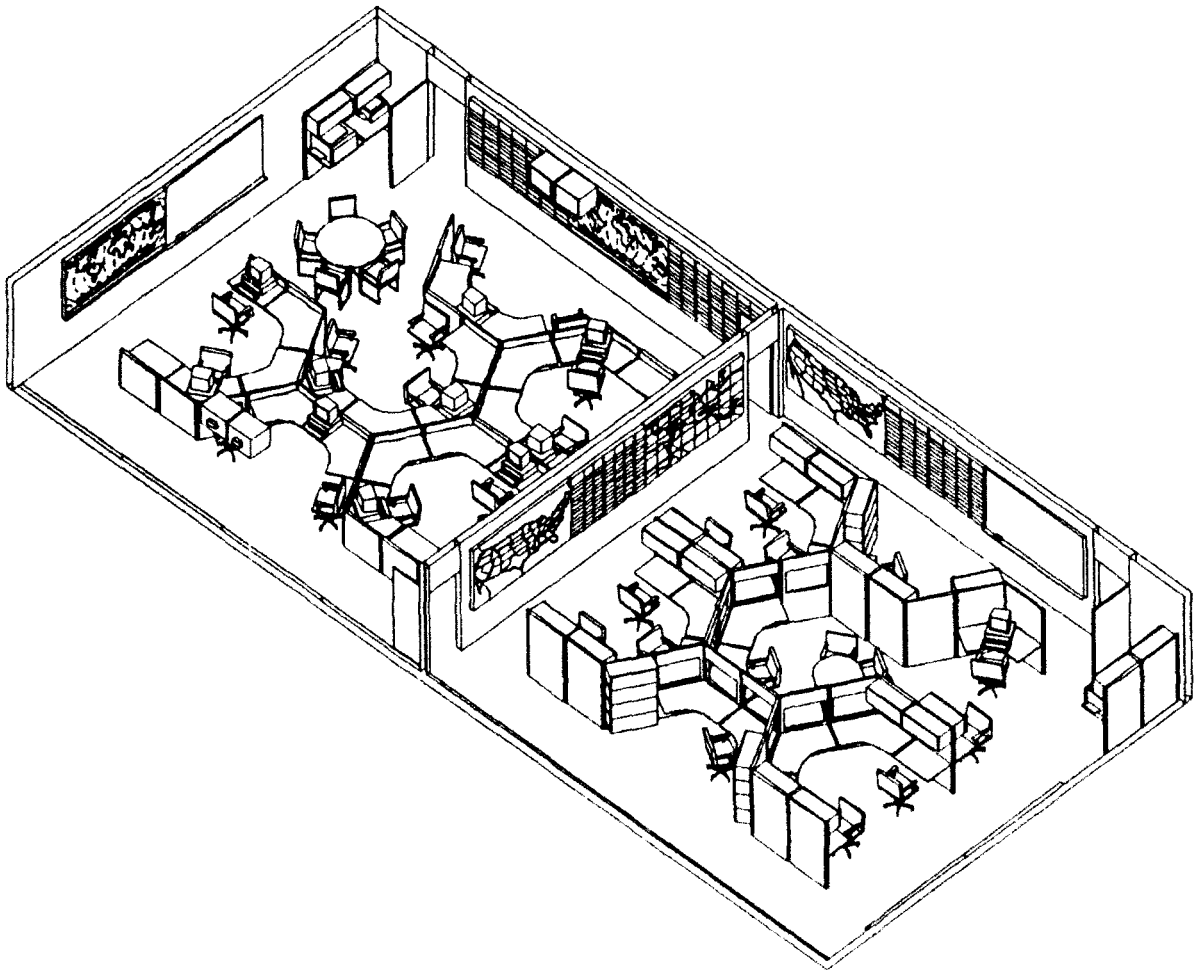
C. Clerical workstation:
- Worksurface with storage
- Word processor
- File cabinet
- Ergonomic chair

D. Visitor's chairs with table

E. Full communications support:
- Autovon
- Commercial
- Red switch
- Intercom

F. Whiteboard/display surface
G. Storage shelving
H. Copier
I. Video monitors
J. Shredder
K. Plasma display boards (4'x8')

guidance/facility component systems



• **Adequate personnel workstation area and appropriate workstation locations:**

1. Provide the action officer (AO) workstation furniture as a continuous counter without any kneehole constraints. This allows for:

a. maximum amount of desk-type worksurface area available.

b. maximum choice of where AO and equipment can be located and/or co-located, especially when additional AOs are required to augment the assigned personnel for short time periods.

• **Effective separation and/or interconnectivity between personnel workstations:**

1. Divider partitions between workstations should be 60 inches high (+/-4 inches) to provide visual privacy while occupants are seated and yet not be confining.

2. A number of divider partitions between workstations should be able to be opened or closed as required to allow for either direct personnel interaction when open or for visual privacy when closed. These convertible partitions are especially relevant for hexagonal workstation configurations since each module has party partitions with several adjacent modules.

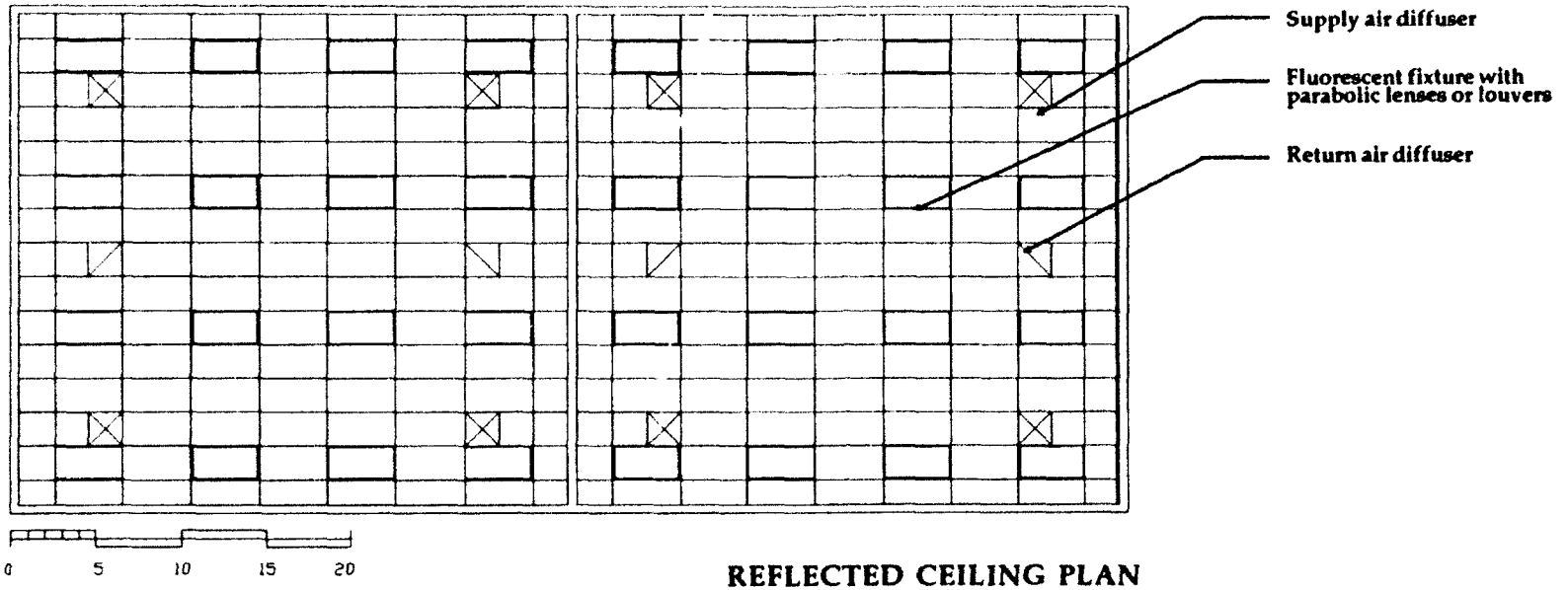
• **Impact of HVAC system noises on acoustical conditions:**

Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.

• **Wall treatment for effective graphic displays:**

1. Provide extensive perimeter wall space to allow for the display and review of completed graphic displays. In addition, a 72" x 48" chalkboard/ whiteboard should be periodically provided for the development and display of conceptual ideas. Arranging the personnel workstations in the center of the space makes much of the perimeter wall surface available for the required graphic display and whiteboards.

guidance/facility component systems



REFLECTED CEILING PLAN

• Minimize reflected glare on VDT screens:

1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

• Optimal building mechanical system for equipment protection:

1. An independent air distribution system for electronic equipment spaces is needed.
2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.
3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall be used in electronic equipment cabinets.
4. Duct fire dampers shall be used in ducts that penetrate two-hour fire resistance-rated walls, partitions, shafts.

• Enable easy ceiling light fixture changes:

1. It is intended that there will be periodic changes in the location of personnel workstations. The ceiling fluorescent light fixtures must be installed in a manner to allow for any fixture unit to be moved to an adjacent ceiling grid module in any direction.

Policy/SOP

The Personnel Readiness Center is typically minimally staffed during non-crisis or day-to-day operations. During these times most personnel concerns will be accomplished through the established Personnel Division within the command center. During periods of crisis, manning expands to suit the requirement, and will shift to continuous operations in support of an activated Crisis Action Team. The Personnel Readiness Center supports the Crisis Action Team through the personnel representative assigned to the CAT. The Logistics Coordination Group must respond rapidly in crisis situations to assemble and provide workstations for the size of group necessary to support crisis logistics activities.

C21
PERSONNEL READINESS CENTER

function

For the timely monitoring, assessment, and compilation of data regarding the state of readiness of combat forces in support of the command center mission.

activities

1. Monitor force readiness.
2. Access/update force readiness database.
3. Prepare readiness reports.
4. Maintain communications link with other command centers.
5. Prepare briefings.

equipment

- Officer workstation:
  - Worksurface with storage
  - Bookshelves
  - File cabinet
  - 2 visitor's chairs
  - Ergonomic chair
- Personnel stations:
  - A one or two position console with full communications support, WIN terminal, printer, and ergonomic seating.
- Terminal with printer
- Full communications support:
  - Autovon
  - Commercial
  - Red switch
  - Intercom
- Whiteboard/display surface
- World clocks

operations

1. Provide the CAT with up-to-date readiness information on combat units.
2. Provide link with other data sources to access management data as requested.
3. Provide support to the CAT operations as directed.
4. Provide force readiness reports and/or briefings as required.

personnel

- 1 readiness officer (per shift)
- 1-2 readiness personnel as needed (per shift)

requirements	criteria	commentary
1. Enough space to accommodate the equipment and personnel associated with the Personnel Readiness Center.	1. Space shall be provided for the monitoring and analysis of force readiness within the command center's AOR. The space for these operations shall be in the range of 400 to 600 sq. ft.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. Interior finishes suitable for durability, maintenance, and room function.	2. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. ***Walls*** Matte paint over plaster, concrete, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	2.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
3. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	3. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise should be between (NC) 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	3.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
4. Comfort features for the occupant such as chair and furniture systems comfort	4. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	4.  See Seating section in CCDH Volume 3 (page 7-5).
5. Adequate lighting.	5. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	5.  See Interior Lighting in CCDH Volume 3 (page 7-55).
6. Adequate climate control.	6. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	6.  See HVAC section in CCDH Volume 3 (page 7-65).
7. Accessible power outlets.	7. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall.	7. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
8. Fire protection/life safety.	8. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	8.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

guidance/facility component systems

• **Minimize numbers of handsets required**:
1. Use red/black interface phones to eliminate the need for multiple handsets.
2. Provide phone handsets with user-friendly single/multiple channel control buttons and with a "message window" that indicates the classification level of the call connection.

• **Adequate communication switching capacity**:
1. The internal and external communication connectivity needs to be optimal during peak crisis periods. Lead team personnel should have state-of-the-art console access.

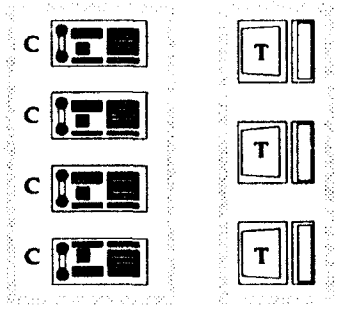
• **Adequate facsimile capability**:
1. Provide both non-secure and secure facsimile machines with at least one spare machine available at each level.
2. Tie in the FAX capability with the LAN system to take advantage of LAN scanner, printers, etc.

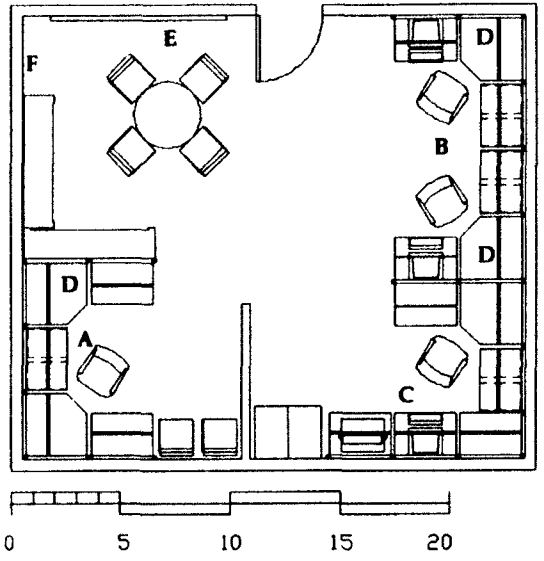
Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.
4. Access to multi-dimensional message service, including electronic mail and file transfers.
5. Access to internal and external facsimile connections that have multi-level-security.

C = communications handset

Information Processing Subsystem Requirements:
1. Access to a multi-dimensional information processing system that includes:
a. automated message handling system (AMHS)
b. multi-media management and storage system
c. text archival/retrieval system
d. mapping system
e. multi-level security (MLS) gateways
f. distributed processing and heterogenous platform connectivity
2. Computer terminals, connected to all relevant command watch teams, e.g., CSS, Intel, Ops, Logistics, etc.

T = computer terminal





Equipment List

A. Officer workstation:
- Worksurface with storage
- Bookshelve(s)/file cabinet(s)
- Ergonomic chair(s)
- 2 visitor's chairs

B. Personnel stations:
- A one or two position console with full communications support, WIN terminal, printer, and ergonomic seating.

C. Terminal with printer

D. Full communications support:
- Commercial
- Autovon
- Red switch
- Intercom

E. Whiteboard/display surface

F. World clocks

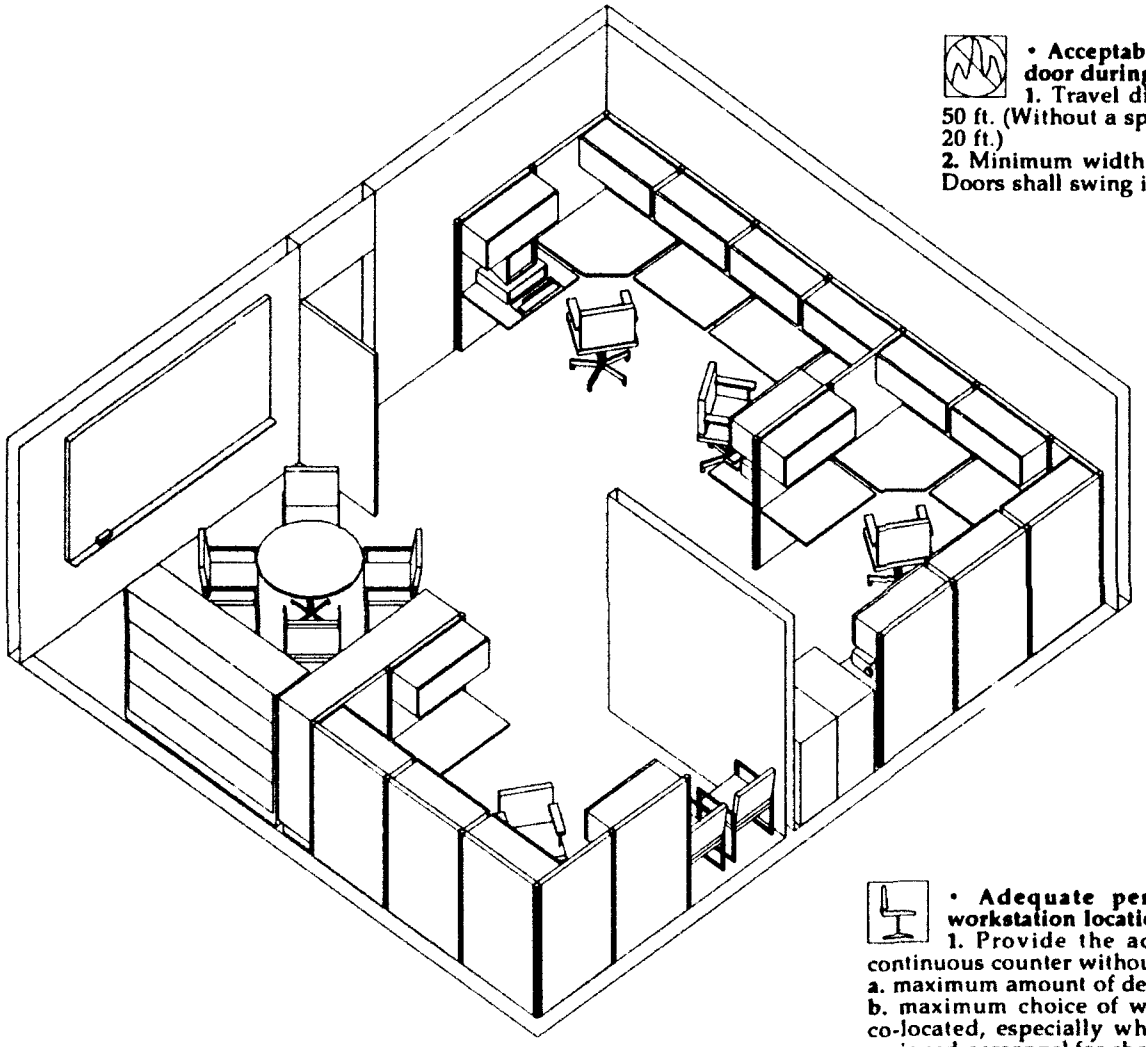
• **Optimum interoperability of the LAN**:
1. In order to take advantage of the IPS currently available, the commands' LAN system will require a UNIX-based platform, and should be compliant with GOSIP, X Window, and Motif standards.
2. AO's connected to the command LAN require terminals similar to UNIX-based integrated workstations.
3. In order to support operations, the LAN requires several laser printers with a minimum of 2 MB of random access memory (RAM).

• **Adequate numbers and quality of computer terminals:**
1. Necessary types of information (e.g.,messages, maps, TV news) can be sent and received.
2. Undetected data errors are negligible.
3. A computer file that is needed quickly (e.g., a photo) can be delivered electronically within one minute to destinations inside the command center and within 10 minutes to remote destinations.

• **Provide optimal LAN connectivity between the command watch teams:**
1. Structure the LAN topology as "communities -of-interest" group LANs (e.g., CAT space, LCC space, Intel Center space that all have common interface during a crisis event).
2. Limit LAN briefing area applications to those that support command decision-making (e.g., JVIDS, mapping, message handling, database management).

• **Adequate numbers and quality of the secure/nonsecure telephone units:**
1. Calls to the telephones of key local and distant individuals are established within 10 seconds or less.
2. Voice clarity over all communication paths is equivalent to STU-111 clarity or better.
3. Provide "precedence" capability to assure the most important C3 messages get through first.

guidance/facility component systems



• **Acceptable travel distance within the space to the nearest door during a fire:**
1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)
2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.

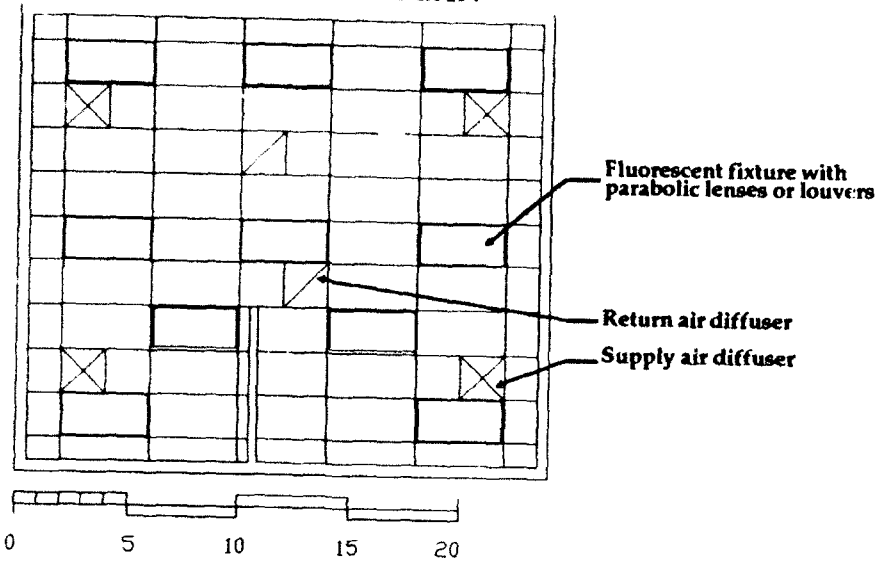
• **Acceptable travel distance to the nearest building exit during a fire:**
1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)

• **Workstation component and seating adjustability for effective ergonomic interaction:**
1. Seating for virtually all positions, clerical, computer operator, technician, and supervisory, should be of the type that is adjustable to a range of tasks and individual needs. Adjustments should include seat height, backrest height, seat pan tilt, and backrest angle.
2. Machine and computer keyboard surfaces are especially important in terms of adjustability -- height, slope, and angle. Video display terminals must be placed at the proper viewing height and angle, along with being adjustable for individual operator needs. Worksurfaces must be located at the proper height for the specified task and be adjustable to suit individual occupant requirements. Suggested surface heights include:
a. working/writing surface: 26"-31".
b. machine interaction surface: 24"-27".
c. computer keyboard surface: 24"-30".

• **Adequate personnel workstation area and appropriate workstation locations:**
1. Provide the action officer (AO) workstation furniture as a continuous counter without any kneehole constraints. This allows for:
a. maximum amount of desk-type worksurface area available.
b. maximum choice of where AO and equipment can be located and/or co-located, especially when additional AOs are required to augment the assigned personnel for short time periods.
2. Provide the AO system furniture workstations using a standard 36" module throughout. This allows for:
a. easy rearrangement of all components since they will all always be compatible with each other.
b. easy removal of individual desk unit components to accommodate floor-mounted equipment, and then the possible replacement of desk units when the equipment is eventually developed as desktop models.

• **Impact of HVAC system noises on acoustical conditions:**
Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.

REFLECTED CEILING PLAN





• **Minimize reflected glare on VDT screens:**
1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.



• **Enable easy ceiling light fixture changes:**
1. It is intended that there will be periodic changes in the location of personnel workstations. The ceiling fluorescent light fixtures must be installed in a manner to allow for any fixture unit to be moved to an adjacent ceiling grid module in any direction.

This part of volume 2 provides generic information for typical support spaces within the command center. Each space is described as a "functional area" where specific mission functions can be effectively accomplished. All relevant information is usually contained on only six pages. This format is intended so that the project manager of an upgrade can remove the six pages for a specific space and copy them for distribution to those involved in a particular function (briefing equipment technicians for the projection room, etc.). This information can be used as a generic reference for:

- Performing evaluations of the existing support spaces within a specific command center
- Developing functional requirements and initial specifications for command center improvement projects
- Developing a concept design for either a new or retrofit command center
- Performing design reviews and evaluations of command center project designs
- Performing evaluations of newly completed or renovated command center support spaces

PART 3 - COMMAND CENTER SUPPORT SPACES

rev. Sept. '91

Policy/SOP

The Telecommunications Center shall be staffed on a 24-hour basis. The center shall have redundant telecommunications systems to allow for uninterrupted operations. Systems shall be tested and periodically maintained according to the manufacturer's recommended schedule of maintenance.

S1
TELECOMMUNICATIONS CENTER

function

For the monitoring, control, and logging of telecommunications, and other related functions of the command center decision making process.

activities

1. Monitor telecommunications equipment.
2. Troubleshoot and reroute to good equipment.
3. Maintain log.
4. Prepare briefings.
5. Periodically check status of telecommunication system.
6. Maintain link with other command centers.
7. Monitor and relay messages.

equipment

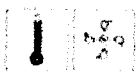
- Telecommunications control console:
  The one or two position console shall be designed so that all systems are easily monitored and controlled. It shall provide access and control of Autovon, Red Switch, commercial, and intercom communications within the command center.
- Ergonomic seating
- File storage
- Reference shelving
- Worksurface with typewriter or word processing equipment and a printer
- Microcomputer
- World clocks

operations

1. Provide uninterrupted telecommunications in support of command center activities.
2. Provide an up-to-date log of telecommunications activities.
3. Provide information as required for briefing purposes.
4. Provide command center conference calling capability.
5. Provide daily telecommunications briefing to CINC.
6. Provide testing and maintenance of the telecommunications equipment.

personnel

- 1-2 telecommunications technicians (per shift). The number of technicians will depend upon the volume of telecommunications traffic at the specified command center.

requirements	criteria	commentary
1. Enough space to accommodate the equipment and personnel associated with the Telecommunications Center.	1. Space shall be provided for the monitoring, control, and logging of telecommunications within the command center. The space may vary greatly among individual command centers based upon the type and amount of equipment present. Estimates, therefore, will be given only for the personnel work areas. The majority of equipment will be placed within the Communications Equipment Area (see space S3). Personnel work areas for the Telecommunications Center shall be in the range of 400 to 600 sq. ft.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. A secure environment for the monitoring of sensitive/critical information during crisis and non-crisis situations.	2. The Telecommunications Center shall be located within the facility so that discussion and presentation of sensitive material in the space cannot be compromised. The access to the space must be controlled so no one may enter without proper clearance. All appropriate equipment in the space must be TEMPEST certified.	2.  See TEMPEST section of the Security Systems in *CCDH Volume 3 (page 7-33).*
3. Interior finishes suitable for durability, maintenance, and room function.	3. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile ***Base*** Vinyl or comparable resilient material	3  See Interior Finishes Systems in CCDH Volume 3 (page 7-43)
4 Acoustical treatment to provide for a non-disruptive environment and isolate variable noise *levels produced by electronic* equipment.	4. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise (NC) should be between NC 35 and NC 40. Reverberation *should be 0.8 seconds at 500Hz*	4  See Acoustical Quality section in CCDH Volume 3 (page 7-51)
5. Comfort features for the occupant such as chair and furniture systems comfort.	5 Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	5  See Seating section in CCDH Volume 3 (page 7-5)
6. Adequate lighting.	6. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	6  See Interior Lighting in CCDH Volume 3 (page 7-55)
7. Adequate climate control.	7. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate	7  See HVAC section in CCDH Volume 3 (page 7-65)
8. Accessible power outlets	8 Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall. Provide a raised floor system that allows for easy access to power connections away from the walls	8 See Electrical Power Systems in CCDH Volume 3 (page 7-70)
9. Fire protection/life safety	9 Fire suppression systems: Automatic Halon 1301, total flooding underfloor system Automatic wet-pipe or pre-action sprinkler system Automatic detection/alarm system for Halon underfloor system	9  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79)

guidance/facility component systems

Information Processing Subsystem Requirements:
1. Computer terminals, connected to all relevant command watch teams, e.g., CSS, Intel, Ops, Logistics, etc.
2. Local Area Network (LAN) with appropriate software capabilities to support immediate data retrieval for decision-makers

T=computer terminal

T T T T

radios

Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.
4. Access to multi-dimensional message service, including electronic mail and file transfers.

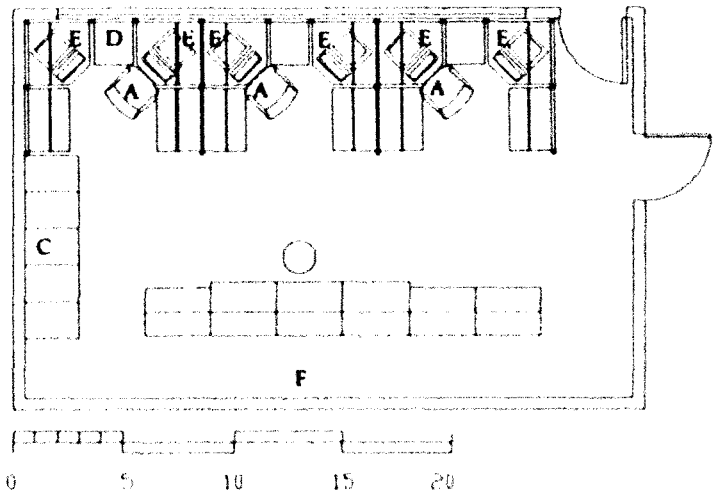
C= communications handset

• **Provide optimal LAN connectivity between the command watch teams:**
1. Structure the LAN topology as "communities -of-interest" group LANs (e.g., CAT space, LCC space, Intel Center space that all have common interface during a crisis event).
2. Limit LAN briefing area applications to those that support command decision-making (e.g., JVIDS, mapping, message handling, database management).

• **Optimum interoperability of the LAN:**
1. In order to take advantage of the IPS currently available, the commands' LAN system will require a UNIX-based platform, and should be compliant with GOSIP, X Window, and Motif standards.
2. AO's connected to the command LAN require terminals similar to UNIX-based integrated workstations.
3. In order to support operations, the LAN requires several laser printers with a minimum of 2 MB of random access memory (RAM).

• **Adequate numbers and quality of the secure/nonsecure telephone units:**
1. Calls to the telephones of key local and distant individuals are established within 10 seconds or less.
2. Voice clarity over all communication paths is equivalent to STU-111 clarity or better.
3. Provide "precedence" capability to assure the most important C3 messages get through first.

• **Adequate numbers and quality of computer terminals:**
1. Necessary types of information (e.g.,messages, maps, TV news) can be sent and received.
2. Undetected data errors are negligible
3. A computer file that is needed quickly (e.g., a photo) can be delivered electronically within one minute to destinations inside the command center and within 10 minutes to remote destinations.

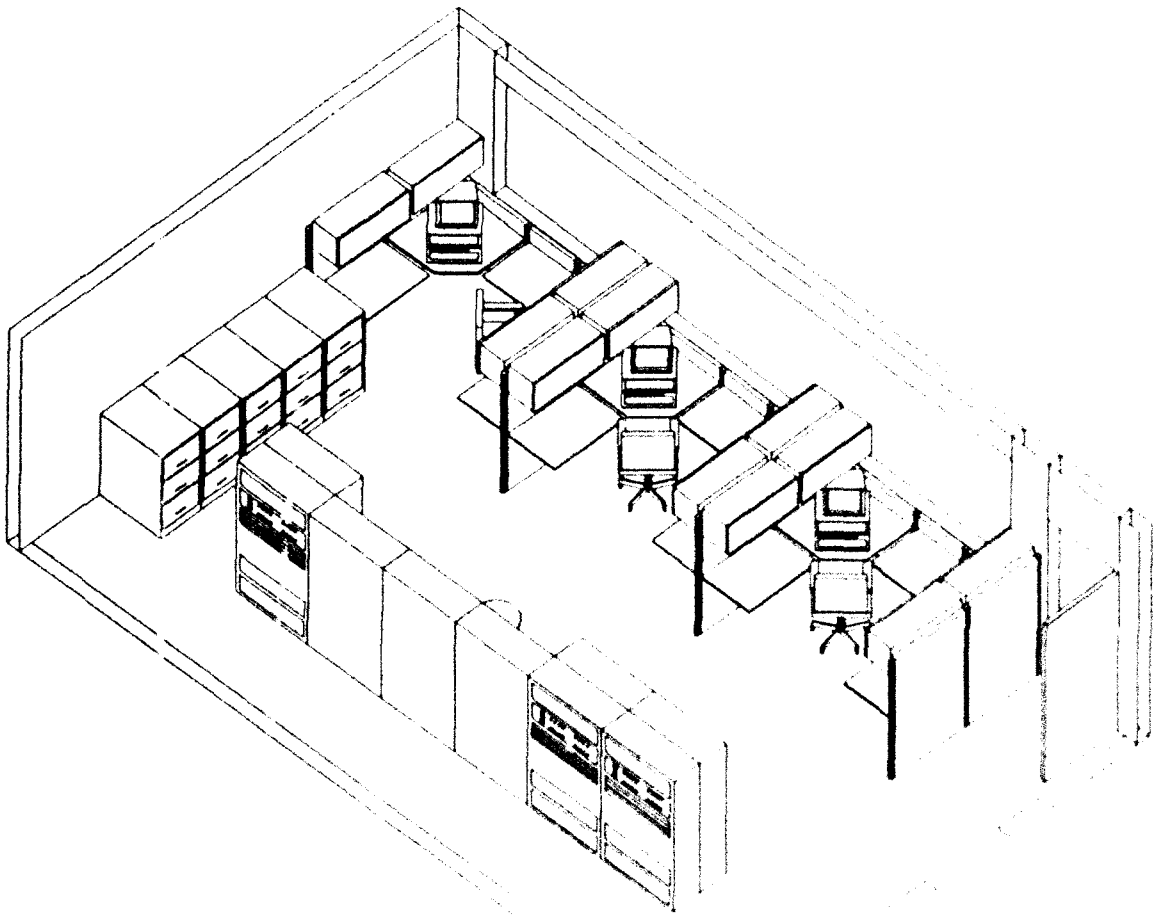


Equipment List

A. **Telecommunication control console:**
   - **The one or two position console shall be designed so that all systems are easily monitored and controlled. It shall provide access and control of Autovon, Red Switch, commercial, and intercom communications within the command center.**

B. **Ergonomic chair(s)**
C. **Bookshelves/file cabinet(s)**
D. **Worksurface with typewriter or word processing equipment and a printer.**
E. **Microcomputer**
F. **World clocks**

guidance/facility component systems



• **Workstation component and seating adjustability for effective ergonomic interaction:**

1. Seating for virtually all positions, clerical, computer operator, technician, and supervisory, should be of the type that is adjustable to a range of tasks and individual needs. Adjustments should include seat height, backrest height, seat pan tilt, and backrest angle.
2. Machine and computer keyboard surfaces are especially important in terms of adjustability -- height, slope, and angle. Video display terminals must be placed at the proper viewing height and angle, along with being adjustable for individual operator needs. Worksurfaces must be located at the proper height for the specified task and be adjustable to suit individual occupant requirements. Suggested surface heights include:
   a. working/writing surface: 26"-31"
   b. machine interaction surface: 24"-27"
   c. computer keyboard surface: 24"-30"

• **Acceptable travel distance within the space to the nearest door during a fire:**

1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)

• **Acceptable travel distance to the nearest building exit during a fire:**

1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)

• **Impact of HVAC system noises on acoustical conditions:**

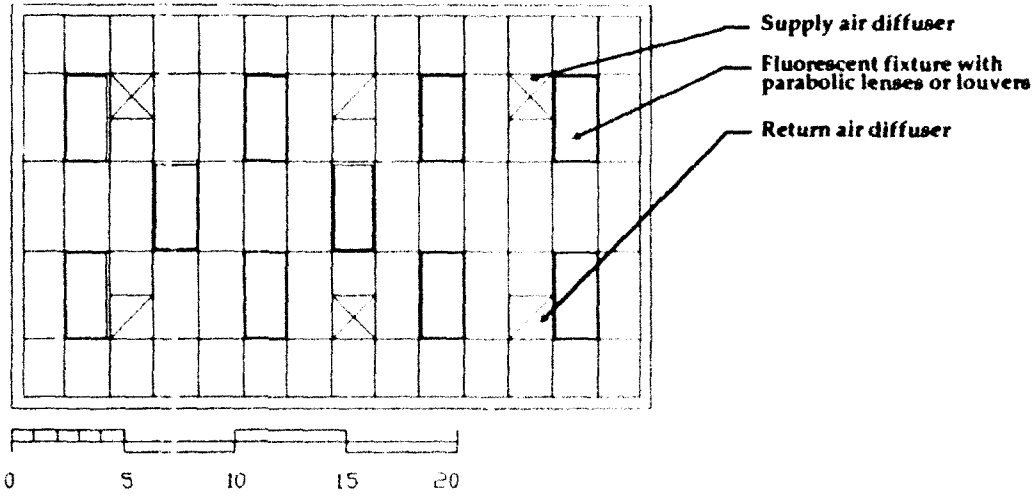
Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.

• **Space located so the personnel can securely and efficiently interact with others -- especially during crisis events:**

1. This functional space should be located within the core of a command center. The desired location is adjacent to or near the Crisis Action Team space.
2. Typical crisis event activities require that this functional space be located within a SCIF.

guidance/facility component systems

REFLECTED CEILING PLAN



• Minimize reflected glare on VDT screens:

1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

• HVAC mechanical system to adequately accommodate electronic-generated heat loads:

1. Heat dissipation by computers, radios, and other electronic equipment is relatively constant; therefore, cooling is required year-round. The room sensible-heat ratio is near unity because heat generated by the computer system is all sensible.
2. The number of required air changes per hour should be 10 to 20 because of the equipment's high heat generation.
3. Humidity control is required year-round to maintain necessary conditions. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components.

• Enable easy ceiling light fixture changes:

1. *It is intended that there will be periodic changes in the location of* personnel workstations. The ceiling fluorescent light fixtures must be installed in a manner to allow for any fixture unit to be moved to an adjacent ceiling grid module in any direction.

• Optimal building mechanical system for equipment protection:

1. An independent air distribution system for electronic equipment spaces is needed.
2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.
3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall be used in electronic equipment cabinets.
4. Duct fire dampers shall be used in ducts that penetrate two-hour fire resistance-rated walls, partitions, shafts.

Policy/SOP

Command center policy would suggest that the best shielding alternative would be the protection of many essential spaces within the center (CAT, Command Briefing Area, Communications Equipment Room, and the CINC Conference Room) from EMP/HEMP. While this may be the best alternative, it is not always feasible, due to the physical characteristics of the facility along with the overall cost of shielding and the availability of funding. If the facility and the funding will not permit the full core of the command center to be shielded, then policy dictates the establishment of a space within which essential communications equipment may be situated so that communications may not be disrupted in the event of an EMP/HEMP condition. During an exercise or an actual EMP/HEMP event, the equipment within the "Steel Box" will be manned continually for the duration of the event.

S2
ESSENTIAL COMMUNICATIONS EQUIPMENT

function

For the essential electronic equipment that requires absolute TEMPEST and EMP/HEMP protection. The communication equipment contained in this vault must provide the command center connectivity to both receive comprehensive information of critical events and disseminate U.S. forces' mission orders.

activities

1. Monitor communications during exercises or EMP/HEMP event.
2. Maintain an essential communications link within the command center.

equipment

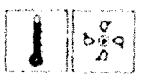
- IEMATS consoles and processors
- AFSATCOM teletypes/terminals
- UHF voice consoles and equipment
- AFSATCOM secure voice and teletype terminals
- WWMCCS and other applicable information database terminals
- Uninterruptable power source
- Environmental support systems
- Black/red telephones
- IEMATS fiber optics interface

operations

1. Provide an uninterrupted communications link in support of the command center mission.
2. Provide a secure and shielded environment for communications equipment during an EMP/HEMP event.

personnel

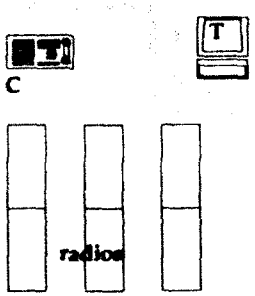
- 2-4 personnel from the DDO, EA, and CWO watch team will man the area during exercises and contingency operations.

requirements	criteria	commentary
1. Enough space for the equipment and operations associated with the Essential Communication Equipment Room.	1. Provide space for the accommodation of all equipment, furniture, and systems to be located within the Essential Communications Equipment Space. The space will vary with the size of the command center communications operation and the amount and type of equipment. Space may range from 300 to 400 sq. ft. It is critical that space be provided for the servicing and maintenance of communications equipment.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. A secure environment for the monitoring of sensitive/critical information during crisis and non-crisis situations.	2. *The Essential Communications Equipment Room shall be located* within the facility so that discussion and presentation of sensitive material in the space cannot be compromised. The access to the space must be controlled so no one may enter without proper clearance. All appropriate equipment in the space must be TEMPEST certified.	2.  See TEMPEST section of the Security Systems in CCDH Volume 3 (page 7-33).
3. Interior finishes suitable for durability, maintenance, and room function.	3. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	3.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
4. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	4. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise (NC) should be between NC 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	4.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
5. Comfort features for the occupant such as chair and furniture systems comfort.	5. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	5.  See Seating section in CCDH Volume 3 (page 7-5).
6. Adequate lighting.	6. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	6.  Interior Lighting in CCDH Volume 3 (page 7-55).
7. Adequate climate control.	7. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	7.  See HVAC section in CCDH Volume 3 (page 7-65).
8. Accessible power outlets.	8. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall. Provide a raised floor system that allows for easy access to power connections away from the walls	8. See Electrical Power Systems in CCDH Volume 3 (page 7-70)
9. Fire protection/life safety.	9. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	9  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79)

guidance/facility component systems

Information Processing Subsystem Requirements:
1. Computer terminals, connected to all relevant command watch teams, e.g., CSS, Intel, Ops, Logistics, etc.
2. Local Area Network (LAN) with appropriate software capabilities to support immediate data retrieval for decision-makers.

T=computer terminal



Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
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3. Observance of protective criteria for red/black and TEMPEST.
4. Access to multi-dimensional message service, including electronic mail and file transfers.

C= communications handset

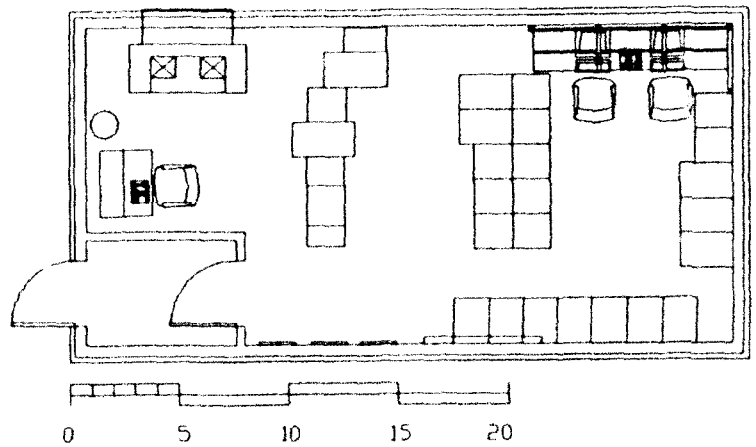
• **Provide optimal LAN connectivity between the command watch teams:**
1. Structure the LAN topology as "communities -of-interest" group LANs (e.g., CAT space, LCC space, Intel Center space that all have common interface during a crisis event).
2. Limit LAN briefing area applications to those that support command decision-making (e.g., JVIDS, mapping, message handling, database management).

• **Optimum interoperability of the LAN:**
1. In order to take advantage of the IPS currently available, the commands' LAN system will require a UNIX-based platform, and should be compliant with GOSIP, X Window, and Motif standards.
2. AO's connected to the command LAN require terminals similar to UNIX-based integrated workstations.
3. In order to support operations, the LAN requires several laser printers with a minimum of 2 MB of random access memory (RAM).

• **Adequate facsimile capability:**
1. Provide both non-secure and secure facsimile machines with at least one spare machine available at each level.
2. Tie in the FAX capability with the LAN system to take advantage of LAN scanner, printers, etc.

• **Adequate numbers and quality of the secure/nonsecure telephone units:**
1. Calls to the telephones of key local and distant individuals are established within 10 seconds or less.
2. Voice clarity over all communication paths is equivalent to STU-111 clarity or better.
3. Provide "precedence" capability to assure the most important C3 messages get through first.

• **Adequate numbers and quality of computer terminals:**
1. Necessary types of information (e.g.,messages, maps, TV news) can be sent and received.
2. Undetected data errors are negligible.
3. A computer file that is needed quickly (e.g., a photo) can be delivered electronically within one minute to destinations inside the command center and within 10 minutes to remote destinations.

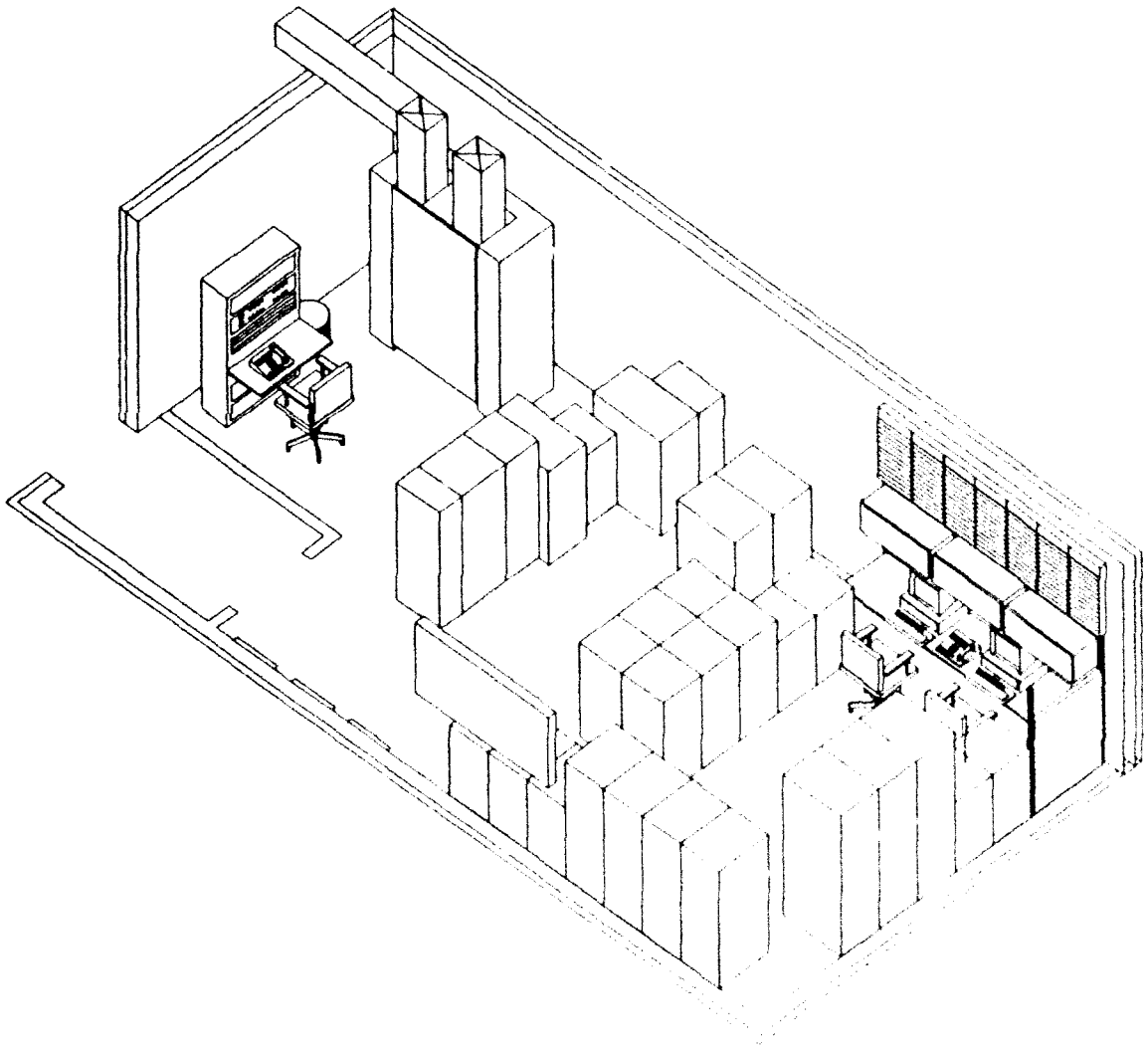


Equipment List

A. IEMATS consoles and processors
B. AFSATCOM teletypes/terminals
C. UHF voice consoles and equipment
D. AFSATCOM secure voice and teletype terminals
E. WWMCCS and other applicable information database terminals
F. Uninterruptable power source
G. Environmental support systems
H. Black/red telephones
I. IEMATS fiber optics interface

Note:
The sensitive nature of operations and equipment being used within this space prohibits the labeling of individual pieces of equipment.

guidance/facility component systems



• Workstation component and seating adjustability for effective ergonomic interaction:

1. Seating for virtually all positions, clerical, computer operator, technician, and supervisory, should be of the type that is adjustable to a range of tasks and individual needs. Adjustments should include seat height, backrest height, seat pan tilt, and backrest angle.
2. Machine and computer keyboard surfaces are especially important in terms of adjustability -- height, slope, and angle. Video display terminals must be placed at the proper viewing height and angle, along with being adjustable for individual operator needs. Worksurfaces must be located at the proper height for the specified task and be adjustable to suit individual occupant requirements. Suggested surface heights include:
   a. working/writing surface: 26"-31"
   b. machine interaction surface: 24"-27"
   c. computer keyboard surface: 24"-30"

• Acceptable travel distance to the nearest building exit during a fire:

1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)

• Space located so the personnel can securely and efficiently interact with others -- especially during crisis events:

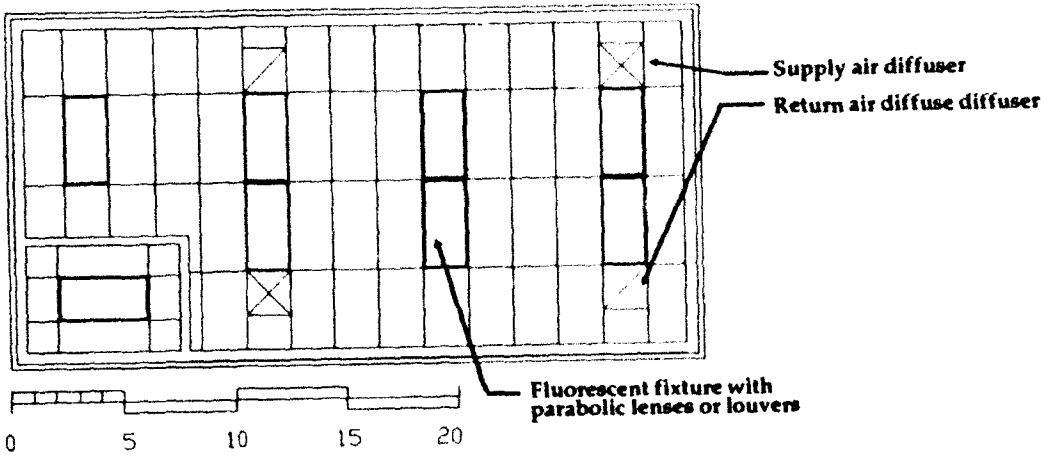
1. This functional space should be located within the core of a command center. The desired location is adjacent to or near the Crisis Action Team space.

• Acceptable travel distance within the space to the nearest door during a fire:

1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)
2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit

guidance/facility component systems

REFLECTED CEILING PLAN



• **Optimal building mechanical system for equipment protection:**

1. An independent air distribution system for electronic equipment spaces is needed.
2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.
3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall be used in electronic equipment cabinets.
4. Duct fire dampers shall be used in ducts that penetrate two-hour fire resistance-rated walls, partitions, shafts.

• **HVAC mechanical system to adequately accommodate electronic-generated heat loads:**

1. Heat dissipation by computers, radios, and other electronic equipment is relatively constant; therefore, cooling is required year-round. The room sensible-heat ratio is near unity because heat generated by the computer system is all sensible.
2. The number of required air changes per hour should be 10 to 20 because of the equipment's high heat generation.
3. Humidity control is required year-round to maintain necessary conditions. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components.

Policy/SOP

The technical control staff provides the essential task of interfacing all communications elements within the command center and is responsible for the overall management of the communications system. The size and type of the technical control area and the communications equipment area shall be determined by the scope of the communication system within the center and the type of equipment in use. *This element will be operational* 24 hours daily to support the round-the-clock operations at the command center.

S3
COMM EQUIP ROOM/ TECH CONTROL

function

For the successful interface of all communications within the command center and for the management and administration effort necessary to support this interface.

activities

1. Control communication quality
2. Analyze communication equipment
3. Administer/supervise communication personnel
4. Type reports
5. Train personnel
6. Coordinate training exercises
7. Monitor technical control console
8. Develop performance reports
9. Develop system and equipment capabilities evaluations

equipment

- NCOIC workstation
  - Worksurface with storage
  - File cabinet
  - Table with seating for 4
  - Bookcase
  - White board
  - Ergonomic chair
- Supervisor workstation
  - Worksurface with storage
  - Locking storage
  - Reference shelf
  - 1 visitor's chair
  - Ergonomic chair
- Technical control workstation
  - Worksurface with storage
  - Typewriter
  - Reference shelving
  - Ergonomic chair
- Technical control console
  - Multiplexers
  - Modems
  - Patch panels
  - Teletypes
  - Distribution frames
- Whiteboard
- Word processing system
- Microcomputer with printer
- Link with information database
- Classified material containers

operations

1. Provide control of all communications systems and equipment within the command center.
2. Provide management of communications equipment.
3. Provide an up-to-date reference manual library for use by communications equipment maintenance personnel.
4. Provide training for communications equipment operations personnel.
5. Provide status reporting of the command center communications system.
6. Provide briefings and/or reports as required.

personnel

- Communications NCOIC
- Shift supervisors
- 2-4 technical control personnel (for each shift)

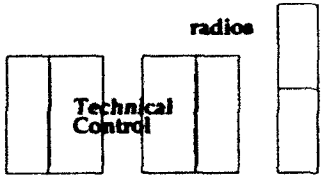
requirements	criteria	commentary
1. Enough space to accommodate the personnel and equipment associated with the technical control of the command center communications system	1. Space shall be provided to allow for the administration, management, and technical control of the command center communication system. The areas may be further divided or subdivided to accommodate the organizational structure and communication system within the individual command center. For the purposes of command center planning, the area shown on page S3-6 is 600 sq. ft.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. A secure environment for the monitoring of sensitive/critical information during crisis and non-crisis situations.	2. The Comm Equipment Room/Tech Control shall be located within the facility so that discussion and presentation of sensitive material in the space cannot be compromised. The access to the space must be controlled so no one may enter without proper clearance. All appropriate equipment in the space must be TEMPEST certified.	2.  See TEMPEST section of the Security Systems in CCDH Volume 3 (page 7-33).
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guidance/facility component systems

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2. Local Area Network (LAN) with appropriate software capabilities to support immediate data retrieval for decision-makers.

T=computer terminal





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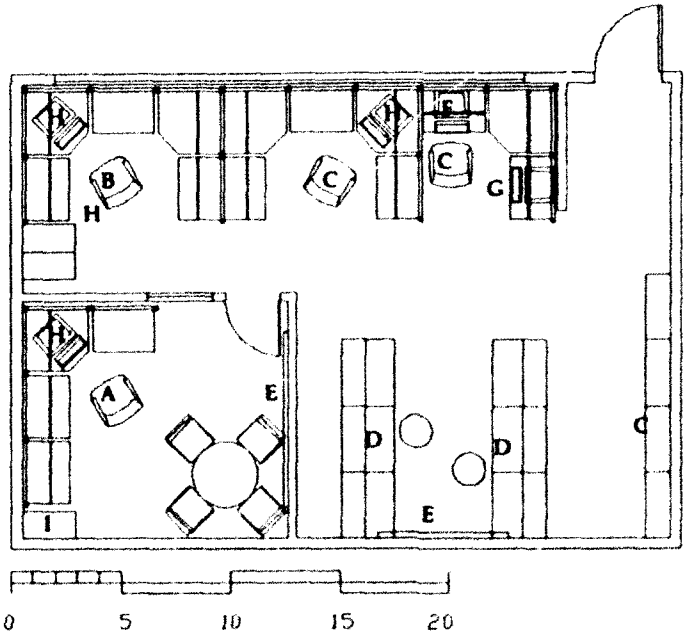
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1. Structure the LAN topology as "communities-of-interest" group LANs (e.g., CAT space, LCC space, Intel Center space that all have common interface during a crisis event).
2. Limit LAN briefing area applications to those that support command decision-making (e.g., JVIDS, mapping, message handling, database management).

• **Optimum interoperability of the LAN:**
1. In order to take advantage of the IPS currently available, the commands' LAN system will require a UNIX-based platform, and should be compliant with GOSIP, X Window, and Motif standards.
2. AO's connected to the command LAN require terminals similar to UNIX-based integrated workstations.
3. In order to support operations, the LAN requires several laser printers with a minimum of 2 MB of random access memory (RAM).

• ***Adequate facsimile capability:***
1. Provide both non-secure and secure facsimile machines with at least one spare machine available at each level.
2. Tie in the FAX capability with the LAN system to take advantage of LAN scanner, printers, etc.

• **Adequate numbers and quality of the secure/nonsecure telephone units:**
1. Calls to the telephones of key local and distant individuals are established within 10 seconds or less.
2. Voice clarity over all communication paths is equivalent to STU-111 clarity or better.
3. Provide "precedence" capability to assure the most important C3 messages get through first.

• **Adequate numbers and quality of computer terminals:**
1. Necessary types of information (e.g.,messages, maps, TV news) can be sent and received.
2. Undetected data errors are negligible.
3. A computer file that is needed quickly (e.g., a photo) can be delivered electronically within one minute to destinations inside the command center and within 10 minutes to remote destinations.



Equipment List

A. NCOIC workstation:
- Worksurface with storage
- Bookshelves/file cabinet(s)
- Ergonomic chair(s)
- Whiteboard
- Table with seating for 4

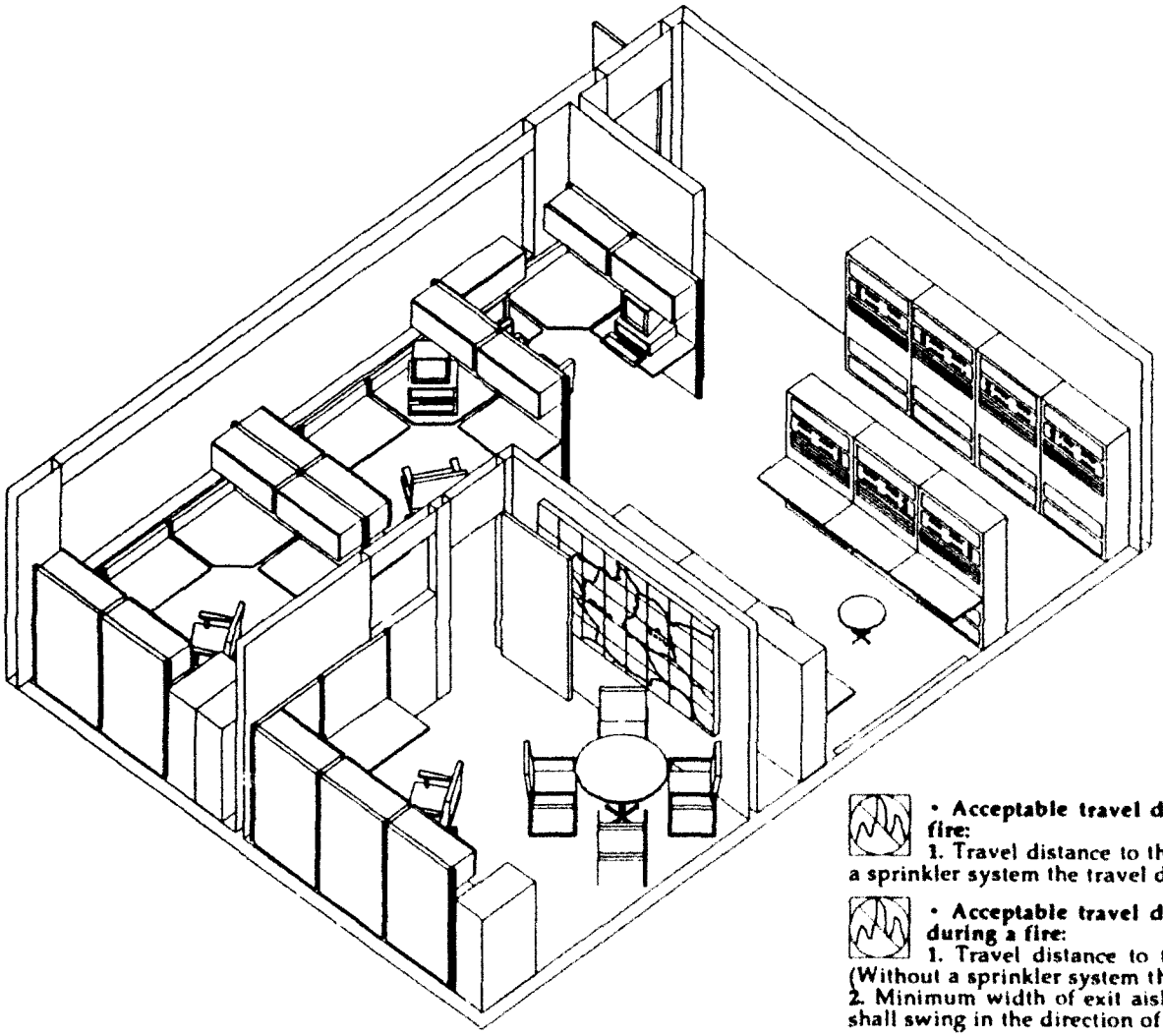
B. Supervisor workstation:
- Worksurface with storage
- Bookshelves
- Ergonomic chair(s)
- Locking storage
- 1 visitor's chair

C. Technical Control workstation:
- Worksurface with storage
- Bookshelves
- Ergonomic chair(s)
- Typewriter

D. Technical control console:
- Multiplexers
- Modems
- Patch panels
- Teletypes
- Distribution frames

E. Whiteboard/display surface
F. Word processing system
G. Microcomputer with printer
H. Link with applicable information databases
I. Classified material container(s)

guidance/facility component systems



• Workstation component and seating adjustability for effective ergonomic interaction:

1. Seating for virtually all positions, clerical, computer operator, technician, and supervisory, should be of the type that is adjustable to a range of tasks and individual needs. Adjustments should include seat height, backrest height, seat pan tilt, and backrest angle.
2. Machine and computer keyboard surfaces are especially important in terms of adjustability -- height, slope, and angle. Video display terminals must be placed at the proper viewing height and angle, along with being adjustable for individual operator needs. Worksurfaces must be located at the proper height for the specified task and be adjustable to suit individual occupant requirements. Suggested surface heights include:
   a. working/writing surface: 26"-31".
   b. machine interaction surface: 24"-27".
   c. computer keyboard surface: 24"-30".

• Acceptable travel distance to the nearest building exit during a fire:

1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)

• Acceptable travel distance within the space to the nearest door during a fire:

1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)
2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.

• Impact of HVAC system noises on acoustical conditions:

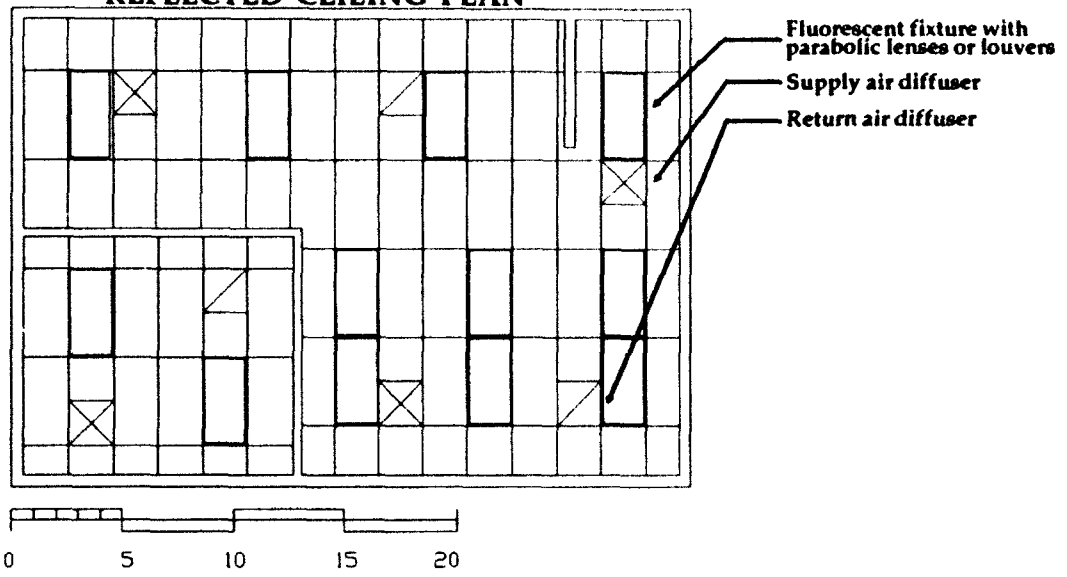
Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.

• Space located so the personnel can securely and efficiently interact with others -- especially during crisis events:

1. This functional space should be located within the core of a command center. The desired location is adjacent to or near the Crisis Action Team space.
2. Typical crisis event activities require that this functional space be located within a SCIF.

guidance/facility component systems

REFLECTED CEILING PLAN



• **HVAC mechanical system to adequately accommodate electronic-generated heat loads:**

1. Heat dissipation by computers, radios, and other electronic equipment is relatively constant; therefore, cooling is required year-round. The room sensible-heat ratio is near unity because heat generated by the computer system is all sensible.
2. The number of required air changes per hour should be 10 to 20 because of the equipment's high heat generation.
3. Humidity control is required year-round to maintain necessary conditions. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components.

• **Optimal building mechanical system for equipment protection:**

1. An independent air distribution system for electronic equipment spaces is needed.
2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.
3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall be used in electronic equipment cabinets.
4. Duct fire dampers shall be used in ducts that penetrate two-hour fire resistance-rated walls, partitions, shafts.

• **Enable easy ceiling light fixture changes:**

1. It is intended that there will be periodic changes in the location of personnel workstations. The ceiling fluorescent light fixtures must be installed in a manner to allow for any fixture unit to be moved to an adjacent ceiling grid module in any direction.

• **Minimize reflected glare on VDT screens:**

1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

Policy/SOP

It is assumed that at the point the WIS becomes operational, policy governing the WIS Center space and related functions shall be similar to that of the WIN Facility. Current policy indicates that the WIN Facility shall be manned daily during normal operations. With the activation of a Crisis Action Team or during an exercise or contingency operation, the WIN Facility will be manned continually. (If EA and CAT spaces are constructed to provide the information classification level required for WWMCCS terminals, the WIS facility space may not be required.)

S4
WIS CENTER

function

For the WWMCCS Information System connectivity for message and data handling capabilities.

operations

1. Provide the CAT with the capability to send and receive classified messages via WIS teleconferences during exercises, crises, and contingencies. Messages are processed in a real-time environment and may be classified up to and including top secret.
2. During CAT operations, provide a WIS site resource manager.
3. Provide HQ staff agencies with the capability to access classified databases at remote WIN terminals. These databases include worldwide airfield information, noncombatant evacuation requirements, airfield throughput capabilities, airflow/distance calculations, and worldwide weather information.
4. Provide HQ staff agencies with the means to process large-scale automated dataflow systems such as FLOGEN, JOPS, and JDS.
5. On a normal day-to-day basis, serve as the WIS system operations manager.

activities

1. Establish teleconferences.
2. Join existing teleconferences.
3. Process WIS messages.
4. Establish WIS requirements for remote units.
5. Manage classified data cell.
6. Support WIS requirements.
7. Recall and schedule augments.
8. Direct priority mode processing for classified system.
9. Establish 24-hour WIS operations.
10. Serve as CAT advisor for WIS operations.
11. Retrieve data for non-WIS customers.
12. Assist WIS customers as required.
13. Maintain "how to" instructions for access to remote data bases.
14. Provide physical access to WIS facilities after duty hours when required.
15. Ensure System 1 is properly configured to efficiently process data.
16. Establish processing priorities.

personnel

- WIS operations officer
- Civilian GS-11 (or above)
- WIS operations NCOIC
- Others as required by operation (See Note)

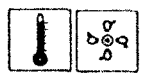
Note:
During exercises, crisis, or contingency operations, the number of personnel will increase to operate available VIP terminals. On-call personnel typically include the following:
VIP Operator
JDS Support Officer
2-3 ADP Watch Officers

equipment

- One remote line printer
- WIS workstations
- WIS magnetic media storage
- Seven side-by-side printers
- Two teletypes
- Two video monitors
- Two bookcases
- Work tables:
  1 48" round
  2 36" X 60"
- One file cabinet
- One supply cabinet
- Shelving for paper storage
- Desk with chair for WIS site coordinator
- Desk with chair for network supervisor
- NCO workstation:
  Desk with chair
  Typewriter

* See "guidance" box for example layout of all equipment listed

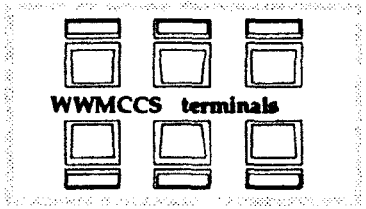
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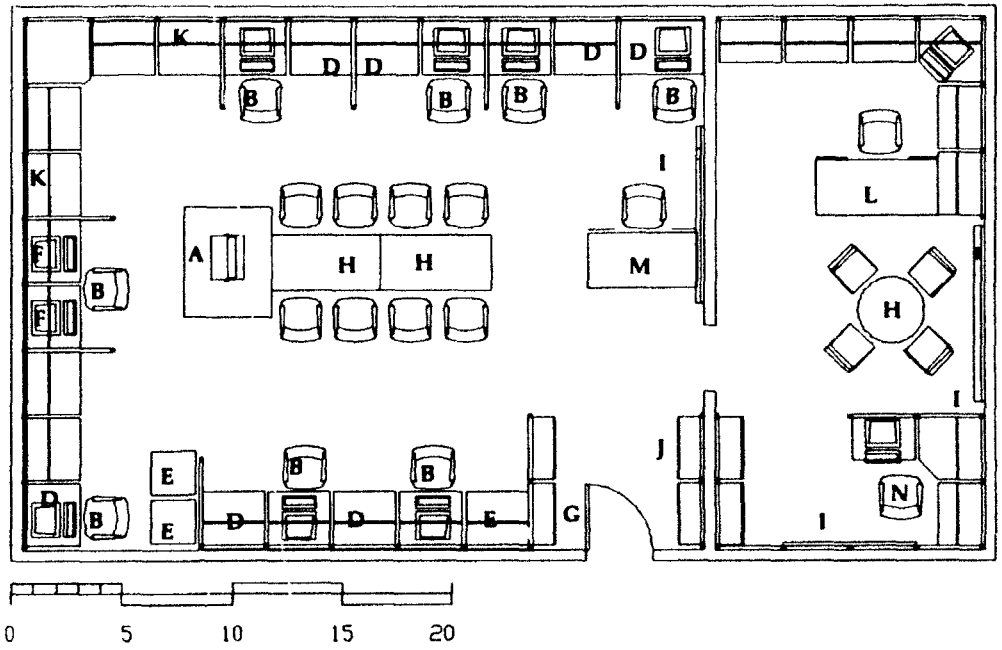
requirements	criteria	commentary
1. Enough space for operating and monitoring database and computer equipment and for proper spacing between equipment to facilitate maintenance.	1. Space varies due to the quantity and range of WIS equipment desired. For the purposes of command center planning, the area shown on page C4-6 is 1050 sq. ft.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. A secure environment for the monitoring of sensitive/critical information during crisis and non-crisis situations.	2. The WIS Center shall be located within the facility so that discussion and presentation of sensitive material in the space cannot be compromised. The access to the space must be controlled so no one may enter without proper clearance. All appropriate equipment in the space must be TEMPEST certified.	2.  See TEMPEST section of the Security Systems in CCDH Volume 3 (page 7-33).
3. Interior finishes suitable for *durability, maintenance, and* room function.	3. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, *hardened concrete.* ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	3.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
4. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	4. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise (NC) should be between NC 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	4.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
5. Comfort features for the occupant such as chair and furniture systems comfort.	5. *Provide each workstation maximum* adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	5.  See Seating section in CCDH Volume 3 (page 7-5).
6. Adequate lighting.	6. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	6.  See Interior Lighting in CCDH Volume 3 (page 7-55).
7. Adequate climate control.	7. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	7.  See HVAC section in CCDH Volume 3 (page 7-65).
8. Accessible power outlets.	8. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall. Provide a raised floor system that allows for easy access to power connections away from the walls.	8. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
9. Fire protection/life safety.	9. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	9.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

guidance/facility component systems

Communication Subsystem Requirements:
Access to required internal systems.

C= communications handset



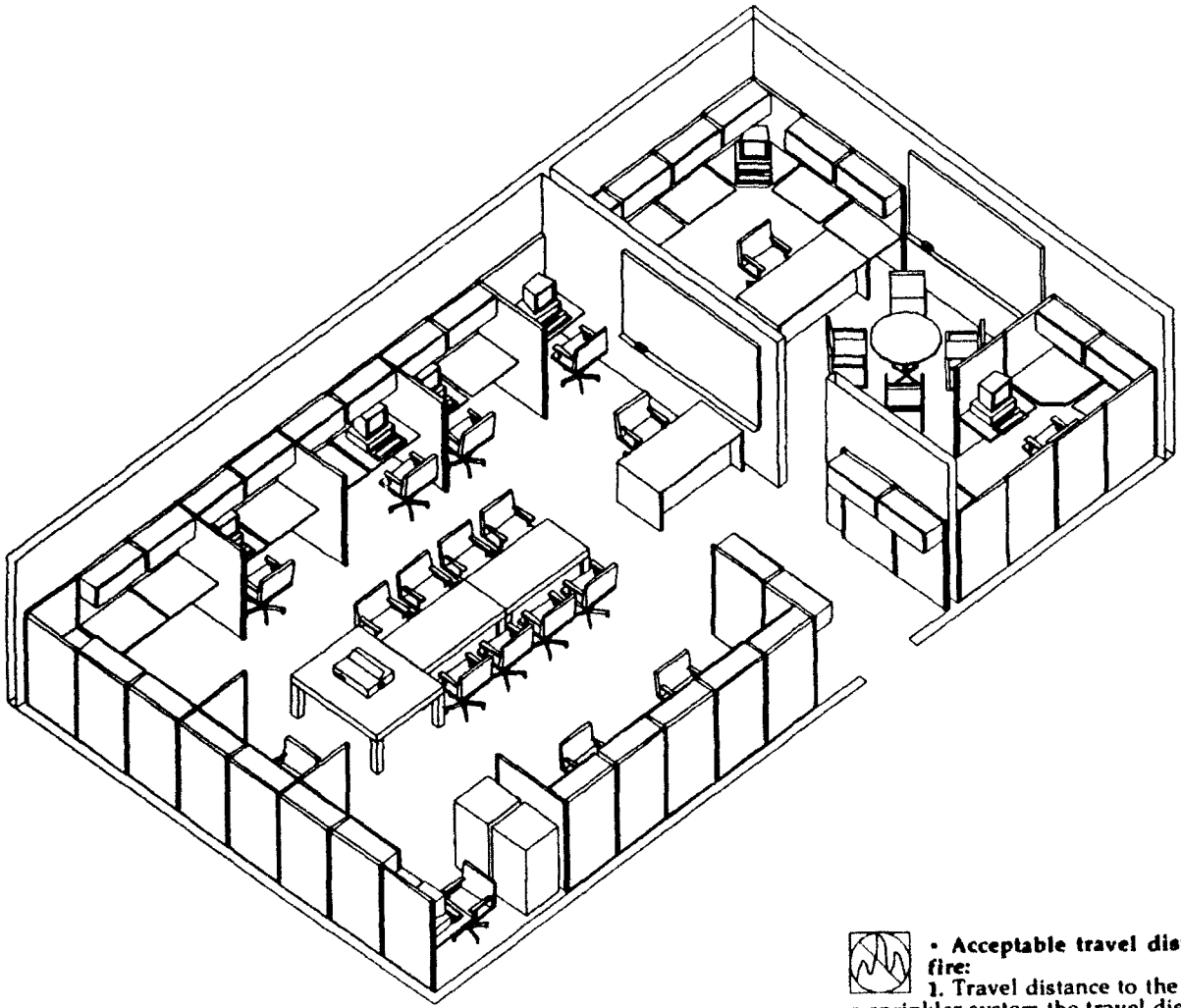


Equipment List

A. One remote line printer
B. WIS workstations
C. WIS magnetic media storage
D. Seven side-by-side printers
E. Two teletypes
F. Two video monitors
G. Two bookcases
H. Work tables:
- 1 48" dia.
- 2 36" x 60"

I. One file cabinet
J. One supply cabinet
K. Shelving for paper storage
L. Desk with chair for WIS site coordinator
M. Desk with chair for network supervisor
N. NCO workstation:
- Desk with chair
- Typewriter

guidance/facility component systems



• Workstation component and seating adjustability for effective ergonomic interaction:

1. Seating for virtually all positions, clerical, computer operator, technician, and supervisory, should be of the type that is adjustable to a range of tasks and individual needs. Adjustments should include seat height, backrest height, seat pan tilt, and backrest angle.
2. Machine and computer keyboard surfaces are especially important in terms of adjustability -- height, slope, and angle. Video display terminals must be placed at the proper viewing height and angle, along with being adjustable for individual operator needs. Worksurfaces must be located at the proper height for the specified task and be adjustable to suit individual occupant requirements. Suggested surface heights include:
   a. working/writing surface: 26"-31".
   b. machine interaction surface: 24"-27".
   c. computer keyboard surface: 24"-30".

• Space located so the personnel can securely and efficiently interact with others -- especially during crisis events:

1. This functional space should be located within the core of a command center. The desired location is adjacent to or near the Crisis Action Team space.
2. Typical crisis event activities require that this functional space be located within a SCIF.

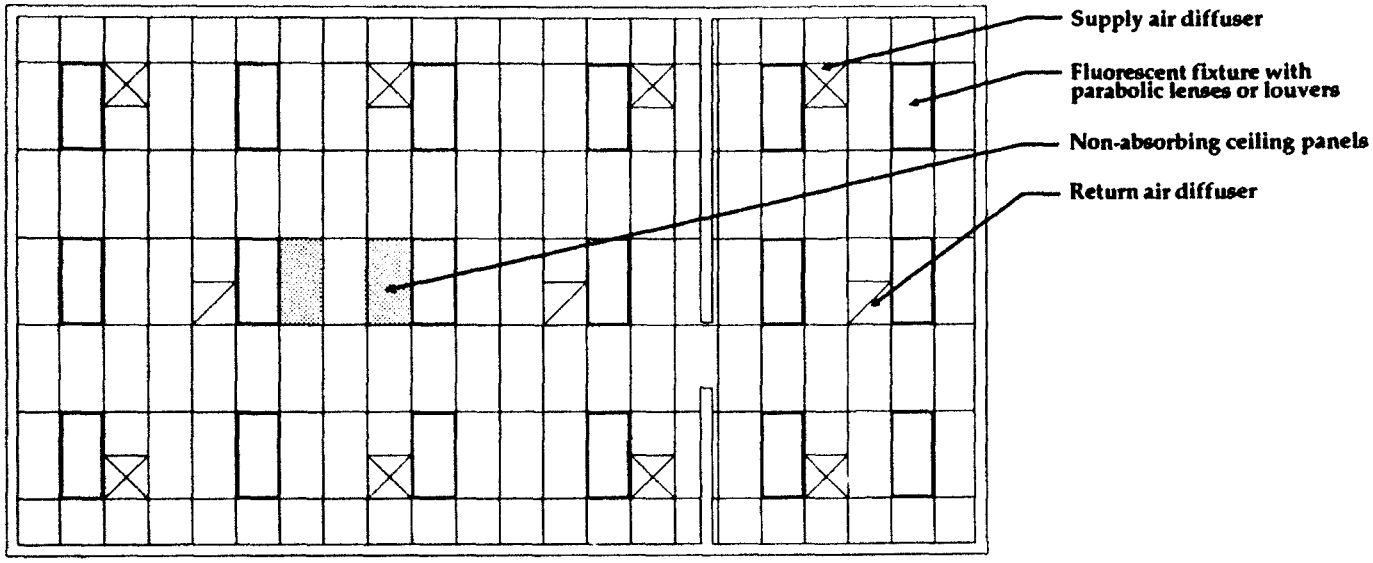
• Acceptable travel distance to the nearest building exit during a fire:

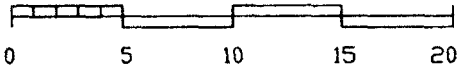
1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)

• Acceptable travel distance within the space to the nearest door during a fire:

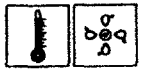
1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)
2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.

guidance/facility component systems





REFLECTED CEILING PLAN



• **HVAC mechanical system to adequately accommodate electronic-generated heat loads:**

1. Heat dissipation by computers, radios, and other electronic equipment is relatively constant; therefore, cooling is required year-round. The room sensible-heat ratio is near unity because heat generated by the computer system is all sensible.
2. The number of required air changes per hour should be 10 to 20 because of the equipment's high heat generation.
3. Humidity control is required year-round to maintain necessary conditions. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components.



• **Impact of HVAC system noises on acoustical conditions:**

Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.



• **Enable easy ceiling light fixture changes:**

1. It is intended that there will be periodic changes in the location of personnel workstations. The ceiling fluorescent light fixtures must be installed in a manner to allow for any fixture unit to be moved to an adjacent ceiling grid module in any direction.



• **Optimal building mechanical system for equipment protection:**

1. An independent air distribution system for electronic equipment spaces is needed.
2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.
3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall be used in electronic equipment cabinets.
4. Duct fire dampers shall be used in ducts that penetrate two-hour fire resistance-rated walls, partitions, shafts.



• **Minimize reflected glare on VDT screens:**

1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

Policy/SOP

It is desirable to provide a separate maintenance area for repair and preventive maintenance activities within the command center. The area shall be secured to the level of the communications and electronic equipment that its staff is assigned to maintain and repair. During preventive maintenance inspections, it will be noted from time to time that some components' performances have deteriorated. Rather than wait for the component to become weaker or to fail completely and interrupt essential command center operations, it is considered good maintenance practice to replace the weak components during the inspection. Thus, although components are replaced before their full service lives have been realized, service interruptions can be avoided. This practice will, in turn, increase the expected replacement parts cost for an operating system; however, the increase is justified on the basis of increased system reliability and the savings in additional manpower costs that would be incurred through the special rush trips to obtain parts or to alert maintenance personnel.

S5
C-E EQUIPMENT MAINTENANCE/ PARTS

function

For the repair and maintenance of communications and electronic equipment used within the command center and for the receiving and storage of parts and supplies necessary to maintain continuous operation of the command center.

activities

1. Inspect communications and electronic equipment.
2. Repair communications and electronic equipment as required.
3. Prepare maintenance reports and recommendations.
4. Participate in or conduct ongoing training or refresher courses for maintenance personnel.
5. Prepare parts inventory and requests.
6. Receive and store incoming parts and components.

equipment

- 2 maintenance/supply workstations:
  - Worksurface with storage
  - Bookcase/file cabinet
  - 1 visitor chair
  - Ergonomic chair
- 2 workbenches with stools
- Reference manual shelving
- File cabinet
- Locking storage cabinet for repair tools and equipment
- Typewriter/word processor
- Shelves for parts storage
- Locking storage cabinets for parts storage
- Open area for receiving and unpacking deliveries
- Telephone/intercom
- Repair schedule status board
- Microcomputer with printer
- Mobile maintenance carts

operations

1. Provide inspection schedule for communications and electronic equipment.
2. Provide recommendations for equipment or component replacement.
3. Provide repair capability for inoperable equipment.
4. Provide training of maintenance personnel.
5. Provide current inventory of repair parts and components.
6. Provide storage and security for parts and repair equipment.

personnel

- Maintenance NCOIC
- Supply specialist
- 1-2 maintenance specialists

requirements	criteria	commentary
1. Enough space to accommodate the personnel and equipment associated with the inspection, repair, and storage of spare parts and components for command center communications electronic equipment.	1. Space shall be provided for the inspection, testing, evaluation, inventory, and repair of command center communications/electronic equipment. In addition, space shall be provided for the receiving and storage of spare parts and components necessary for support of continuous, uninterrupted operations. Typical space requirements would be in the range of 500 sq. ft. for the maintenance area and 600 sq. ft. for the parts receiving and storage area.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. Interior finishes suitable for durability, maintenance, and room function.	2. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	2.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
3. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	3. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise (NC) should be between NC 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	3.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
4. Comfort features for the occupant such as chair and furniture systems comfort.	4. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	4.  See Seating section in CCDH Volume 3 (page 7-5).
5. Adequate lighting.	5. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	5.  Interior Lighting in CCDH Volume 3 (page 7-55).
6. Adequate climate control.	6. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	6.  See HVAC section in CCDH Volume 3 (page 7-65).
7. Accessible power outlets.	7. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall.	7. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
8. Fire protection/life safety.	8. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	8.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

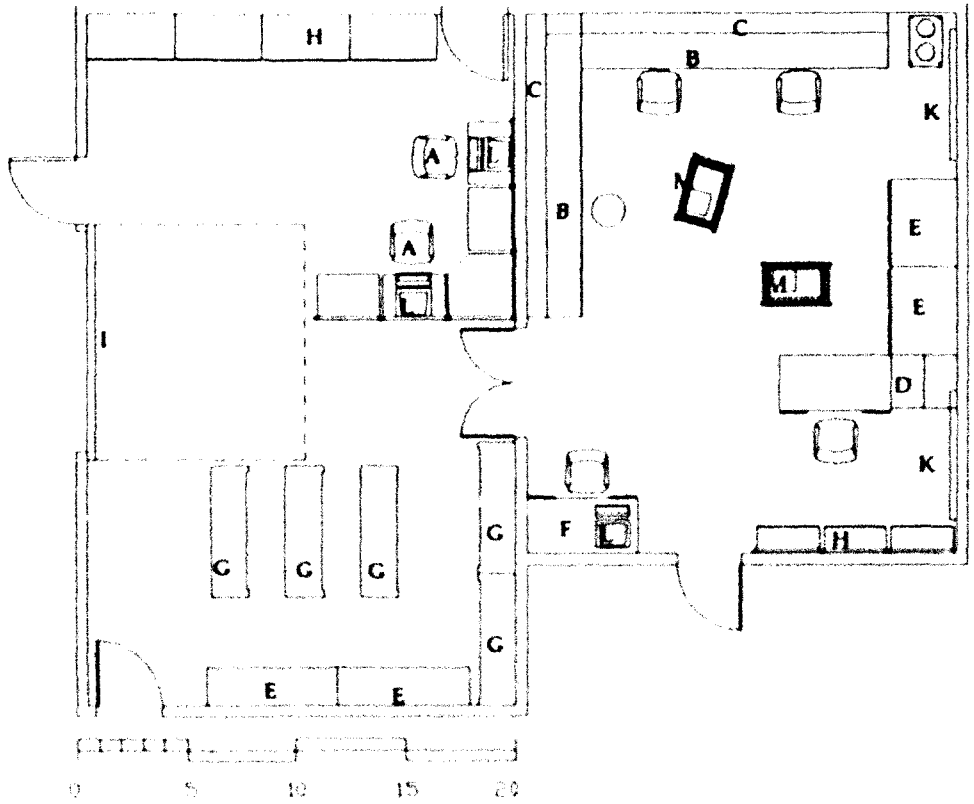
guidance/facility component systems

Information Processing Subsystem Requirements:
1. Local Area Network (LAN) with appropriate software capabilities to support immediate data retrieval for decision-makers.

T= computer terminal

T T T

Optimum interoperability of the LAN:
1. In order to take advantage of the IPS currently available, the commands' LAN system will require a UNIX-based platform, and should be compliant with GOSIP, X Window, and Motif standards.
2. AO's connected to the command LAN require terminals similar to UNIX-based integrated workstations.
3. In order to support operations, the LAN requires several laser printers with a minimum of 2 MB of random access memory (RAM).

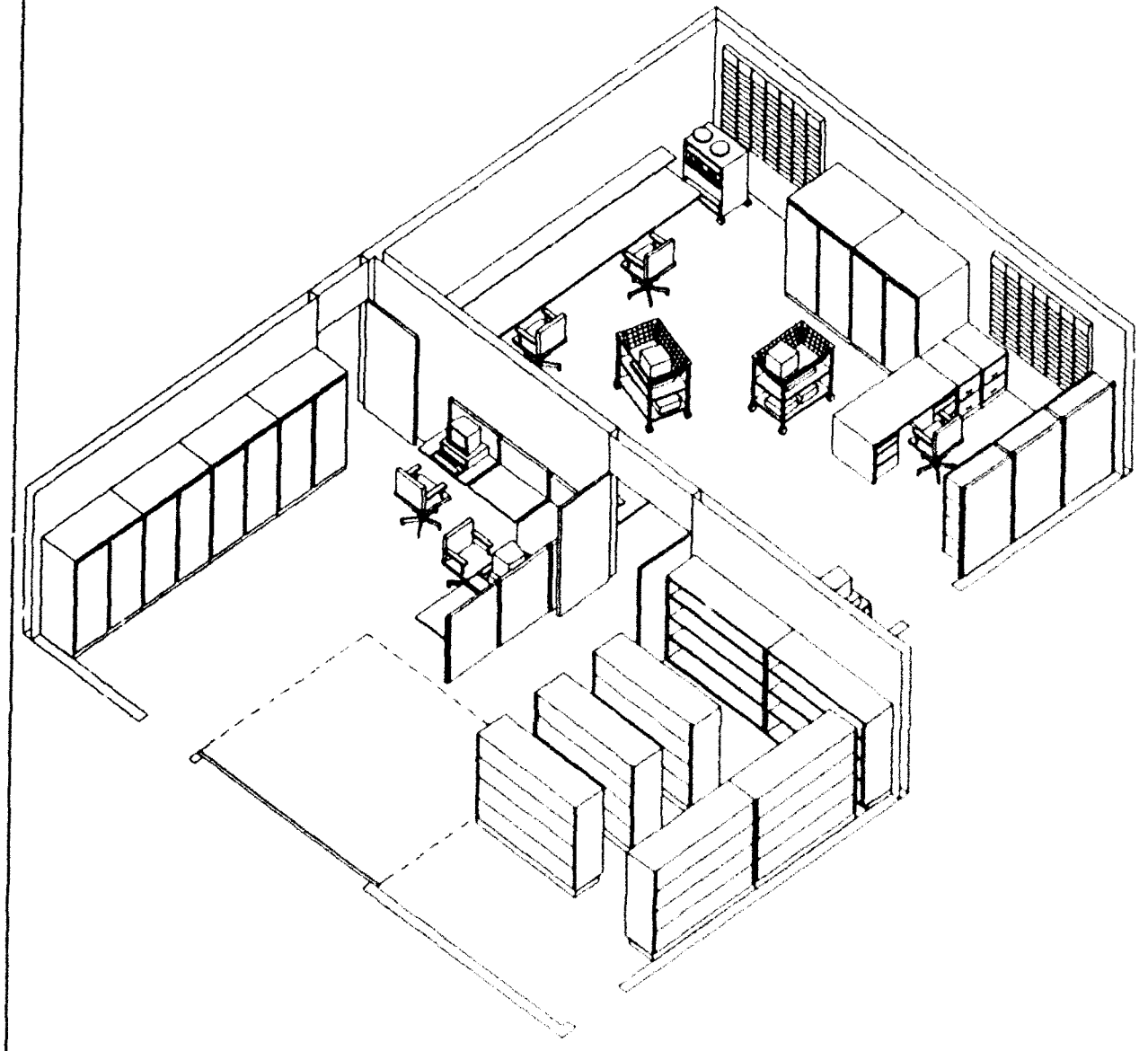


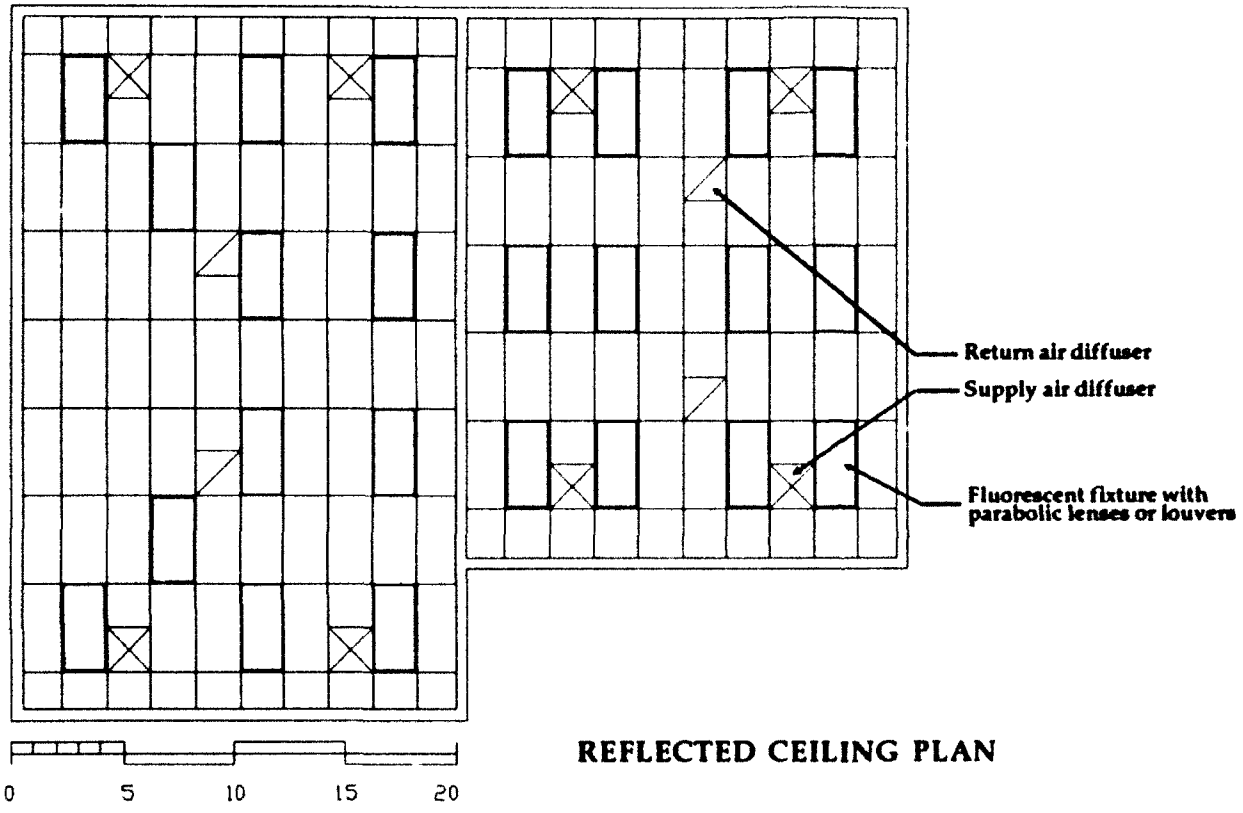
Equipment List

A. 2 maintenance/supply workstations:
- Worksurface storage
- Bookshelves/file cabinet(s)
- Ergonomic chair(s)
- 1 visitor's chair

B. 2 workbenches with stools/chairs
C. Reference manual shelving
D. File cabinet
E. Locking storage cabinet for repair tools and equipment
F. Typewriter/word processor
G. Shelves for parts storage
H. Locking storage cabinets for parts storage
I. Open area for receiving and unpacking deliveries
J. Telephone/intercom
K. Repair schedule status board
L. Micro computer with printer
M. Mobile maintenance carts

guidance/facility component systems





REFLECTED CEILING PLAN

Policy/SOP

The information about Space Type S6 can relate to any of the command divisional AO and administration areas, such as Operations Division, Intelligence Division, etc.

S6
DIVISION AO OFFICES AND ADMINISTRATIVE AREA

function

For the direct operation and supervision of the command center, and for the development and execution of approved plans in support of the command center mission and in relation to the command center's area of responsibility.

operations

1. Provide direct participation in a CAT when activated.
2. Provide monitoring and reporting capability for the command center.
3. Provide information to operation and deployment plans.
4. Provide and maintain emergency action plans and documents.
5. Provide briefings on area of responsibility status conditions.
6. Provide periodic situation reports for submittal to the CINC as required.
7. Provide assistance and support to the Senior Battle Staff.

activities

1. Monitor current situation.
2. Relay any significant events to the appropriate personnel.
3. Relay all necessary communication to the appropriate personnel.
4. Brief incoming shift personnel on current situation.
5. Perform daily security check of assigned area.
6. Brief others as necessary.
7. Execute approved operational plans as required.
8. Maintain emergency action plans and documents.

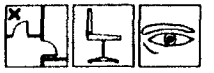
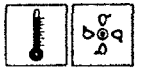
personnel

- 1 division chief
- 2-4 deputies
- 16-20 action officers
- 2 clerical personnel

equipment

- Division chief/deputy office:
  - Desk with storage
  - Credenza
  - Bookcase
  - 6-8 visitor's chairs with table
  - Whiteboard
  - Ergonomic chair
- Action officer workstation:
  - Worksurface with storage
  - Bookshelves
  - Ergonomic chair
- Clerical support:
  - Worksurface with storage
  - Bookshelves/file cabinets
  - Ergonomic chairs
- Common use terminal with printer
- Link with all applicable databases
- Reference/work area
- Classified material storage containers
- Whiteboard/display surface
- World clocks

notes

requirements	criteria	commentary
1. Enough space to accommodate the personnel and equipment associated with any operational division.	1. Space shall be provided for division action officers in support of both day-to-day and crisis situations. The space shown may be divided or sub-divided into additional areas, as required by the organizational structure of the individual command center. The space has been apportioned into two general areas as follows: Enclosed offices/conference areas 50 sq. ft. Open area AO modules 90 sq. ft. per person	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. Interior finishes suitable for durability, maintenance, and room function.	2. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	2.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
3. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	3. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise (NC) should be between NC 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	3.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
4. Comfort features for the occupant such as chair and furniture systems comfort.	4. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	4.  See Seating section in CCDH Volume 3 (page 7-5).
5. Adequate lighting.	5. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	5.  See Interior Lighting in CCDH Volume 3 (page 7-55).
6. Adequate climate control.	6. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	6.  See HVAC section in CCDH Volume 3 (page 7-65).
7. Accessible power outlets.	7. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall. Provide a raised floor system that allows for easy access to power connections away from the walls.	7. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
8. Fire protection/life safety.	8. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	8.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

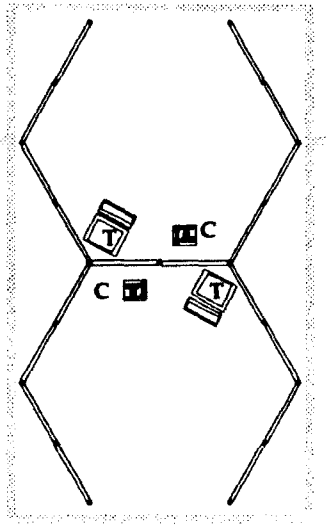
guidance/mission support systems for communication and information processing

• **Adequate numbers and quality of computer terminals:**
1. Necessary types of information (e.g.,messages, maps, TV news) can be sent and received.
2. Undetected data errors are negligible.
3. A computer file that is needed quickly (e.g., a photo) can be delivered electronically within one minute to destinations inside the command center and within 10 minutes to remote destinations.

• **Adequate numbers and quality of the secure/nonsecure telephone units:**
1. Calls to the telephones of key local and distant individuals are established within 10 seconds or less.
2. Voice clarity over all communication paths is equivalent to STU-111 clarity or better.
3. Provide "precedence" capability to assure the most important C3 messages get through first.

Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.
4. Access to multi-dimensional message service, including electronic mail and file transfers.
5. Access to internal and external facsimile connections that have multi-level-security.

C = communications handset



Information Processing Subsystem Requirements:
1. Local Area Network (LAN) with appropriate software capabilities to support immediate data retrieval for decision-makers.

T= computer terminal

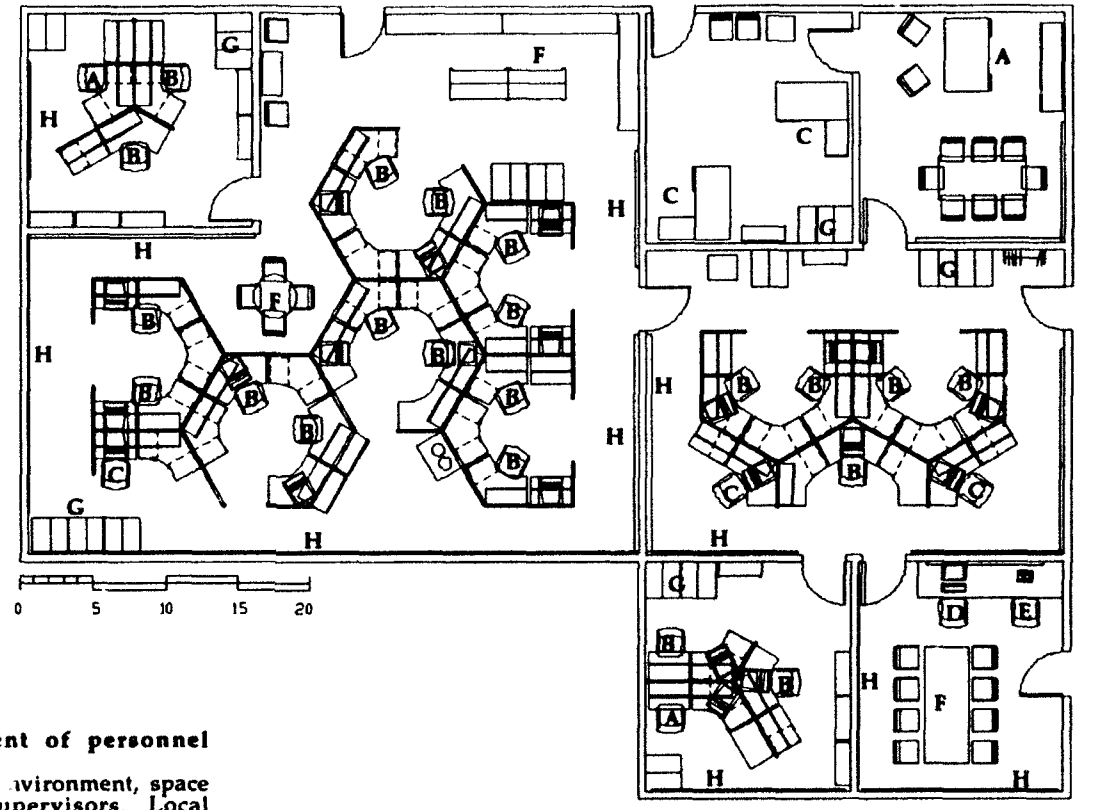
• **Adequate facsimile capability:**
1. Provide both non-secure and secure facsimile machines with at least one spare machine available at each level.
2. Tie in the FAX capability with the LAN system to take advantage of LAN scanner, printers, etc.

guidance/facility component systems

• Acceptable travel distance within the space to the nearest door during a fire:
1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)
2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.

• Acceptable travel distance to the nearest building exit during a fire:
1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)

• Optimal individual choice for the extent and location of the componentry in personnel workstation modules:
1. Provide personnel workstations using system furniture componentry with a single modular dimension of 36". This allows for:
a. easy rearrangement of all components since they will always be compatible with each other.
b. easy removal of individual desk unit components to accommodate floor-mounted equipment, and then the possible replacement of desk units when the equipment is eventually developed as desktop models. Personnel workstations using system furniture 36" components can be configured as either rectangular or hexagonal modules. The hexagonal modules are recommended for this space.



• Optimal choice for the rearrangement of personnel workstation modules:
1. To maintain a responsive, efficient work environment, space management should be localized with the first supervisors. Local planning and management are needed to retain equitable space allocation, to maintain previously established standards, and to respond efficiently to changing situations.

• Impact of HVAC system noises on acoustical conditions:
Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.

Equipment List

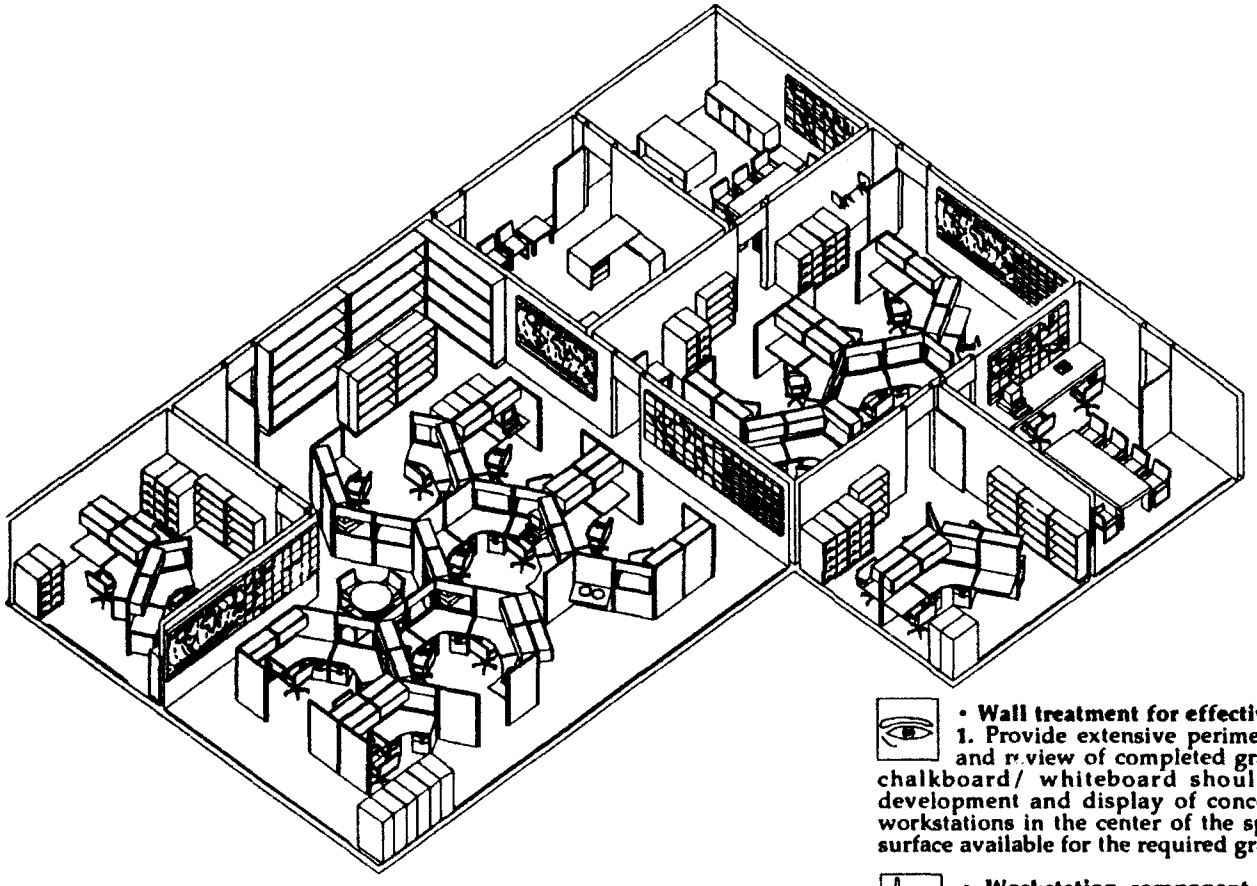
A. Division chief/deputy office:
- Desk with storage
- Credenza
- Bookcase
- 6-8 visitor's chairs with table
- Whiteboard
- Ergonomic chair(s)

B. Action officer workstation:
- Worksurface with storage
- Bookshelves/file cabinet(s)
- Ergonomic chair(s)
- 1-2 visitor's chairs

C. Clerical support workstation:
- Worksurface with storage
- Bookshelves/file cabinets
- Ergonomic chairs

D. Common use terminal with printer
E. Link with applicable info databases
F. Reference/work area
G. Classified material container(s)
H. Whiteboard/display surface
I. World clocks

guidance/facility component systems



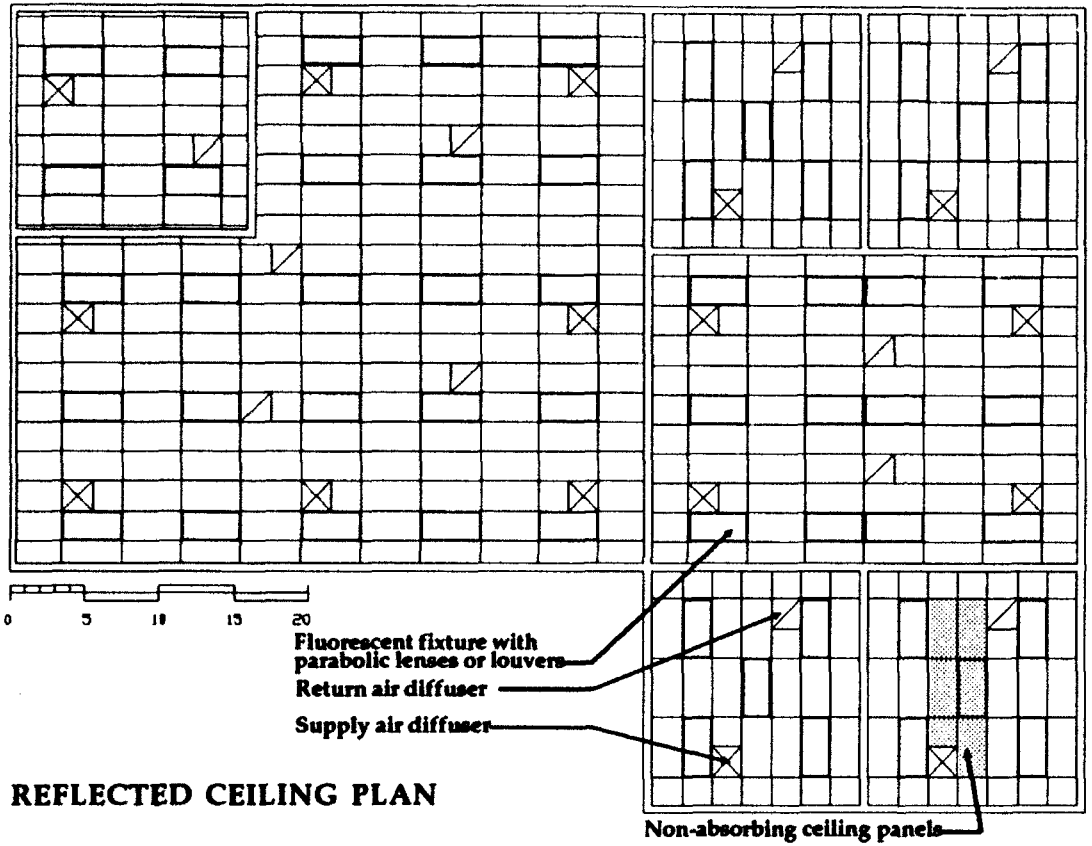
• **Effective separation and/or interconnectivity between personnel workstations:**
1. Divider partitions between workstations should be 60 inches high (+/-4 inches) to provide visual privacy while occupants are seated and yet not be confining.
2. A number of divider partitions between workstations should be able to be opened or closed as required to allow for either direct personnel interaction when open or for visual privacy when closed. These convertible partitions are especially relevant for hexagonal workstation configurations since each module has party partitions with several adjacent modules.

• **Wall treatment for effective graphic displays:**
1. Provide extensive perimeter wall space to allow for the display and review of completed graphic displays. In addition, a 72" x 48" chalkboard/ whiteboard should be periodically provided for the development and display of conceptual ideas. Arranging the personnel workstations in the center of the space makes much of the perimeter wall surface available for the required graphic display and whiteboards.

• **Workstation component and seating adjustability for effective ergonomic interaction:**
1. Seating for virtually all positions, clerical, computer operator, technician, and supervisory, should be of the type that is adjustable to a range of tasks and individual needs. Adjustments should include seat height, backrest height, seat pan tilt, and backrest angle.
2. Machine and computer keyboard surfaces are especially important in terms of adjustability -- height, slope, and angle. Video display terminals must be placed at the proper viewing height and angle, along with being adjustable for individual operator needs. Worksurfaces must be located at the proper height for the specified task and be adjustable to suit individual occupant requirements. Suggested surface heights include:
a. working/writing surface: 26"-31".
b. machine interaction surface: 24"-27".
c. computer keyboard surface: 24"-30".

• **Adequate personnel workstation area and appropriate workstation locations:**
1. Provide the action officer (AO) workstation furniture as a continuous counter without any kneehole constraints. This allows for:
a. maximum amount of desk-type worksurface area available.
b. maximum choice of where AO and equipment can be located and/or co-located, especially when additional AOs are required to augment the assigned personnel for short time periods.

guidance/facility component systems



REFLECTED CEILING PLAN

• Minimize reflected glare on VDT screens:

1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

• Enable easy ceiling light fixture changes:

1. It is intended that there will be periodic changes in the location of personnel workstations. The ceiling fluorescent light fixtures must be installed in a manner to allow for any fixture unit to be moved to an adjacent ceiling grid module in any direction.

• Optimal building mechanical system for equipment protection:

1. An independent air distribution system for electronic equipment spaces is needed.
2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.
3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall be used in electronic equipment cabinets.
4. Duct fire dampers shall be used in ducts that penetrate two-hour fire resistance-rated walls, partitions, shafts.

• Acceptable travel distance within the space to the nearest door during a fire:

1. Travel distance to the nearest exit shall not exceed 50 ft. (without a sprinkler systemthe travel distance shall not exceed 20 ft.)
2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.

• HVAC mechanical system to adequately accommodate electronic-generated heat loads:

1. Heat dissipation by computers, radios, and other electronic equipment is relatively constant; therefore, cooling is required year-round. The room sensible-heat ratio is near unity because heat generated by the computer system is all sensible.
2. The number of required air changes per hour should be 10 to 20 because of the equipment's high heat generation.
3. Humidity control is required year-round to maintain necessary conditions. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components.

guidance/mission support systems for communication and information processing

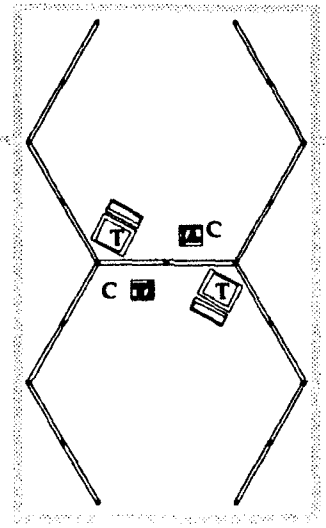
NOTE: The Command Briefing Area shown on pages C14-9 thru C14-12 is a smaller version of Space C14. The information shown on pages C14-1 thru C14-5 also applies to this smaller configuration.

• **Adequate facsimile capability**:
1. Provide both non-secure and secure facsimile machines with at least one spare machine available at each level.
2. Tie in the FAX capability with the LAN system to take advantage of LAN scanner, printers, etc.

• **Adequate numbers and quality of the secure/nonsecure telephone units:**
1. Calls to the telephones of key local and distant individuals are established within 10 seconds or less.
2. Voice clarity over all communication paths is equivalent to STU-111 clarity or better.
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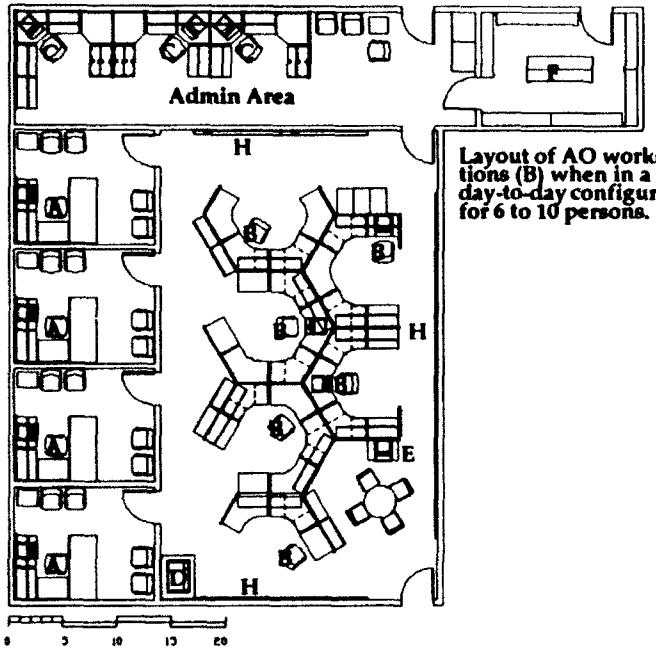


Information Processing Subsystem Requirements:
1. Local Area Network (LAN) with appropriate software capabilities to support immediate data retrieval for decision-makers.

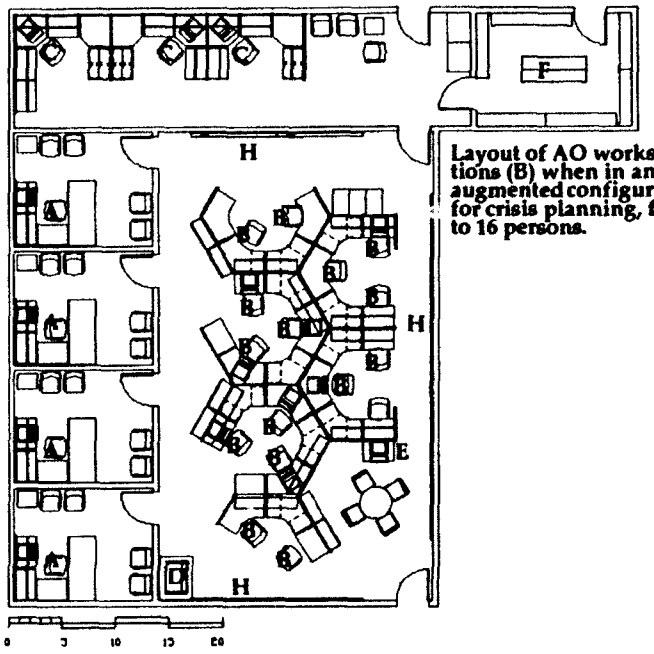
T= computer terminal

• **Adequate numbers and quality of computer terminals:**
1. Necessary types of information (e.g.,messages, maps, TV news) can be sent and received.
2. Undetected data errors are negligible.
3. A computer file that is needed quickly (e.g., a photo) can be delivered electronically within one minute to destinations inside the command center and within 10 minutes to remote destinations.

guidance/facility component systems



Layout of AO workstations (B) when in a normal day-to-day configuration, for 6 to 10 persons.



Layout of AO workstations (B) when in an augmented configuration for crisis planning, for 12 to 16 persons.

Equipment List

A. Division Chief/Deputy office:
- Desk with storage
- Credenza
- Bookcase
- Whiteboard
- Ergonomic chair(s)

B. Action Offier workstation
- Worksurface with storage
- Bookshelve(s)/file cabinet(s)
- Ergonomic chair(s)

C. Clerical Support
- Worksurface with storage
- Bookshelve(s)/file cabinets
- Ergonomic chairs

D. Copier
E. Link with all applicable databases
F. Reference/work area
G. Classified material container(s)
H. Whiteboard/display surface

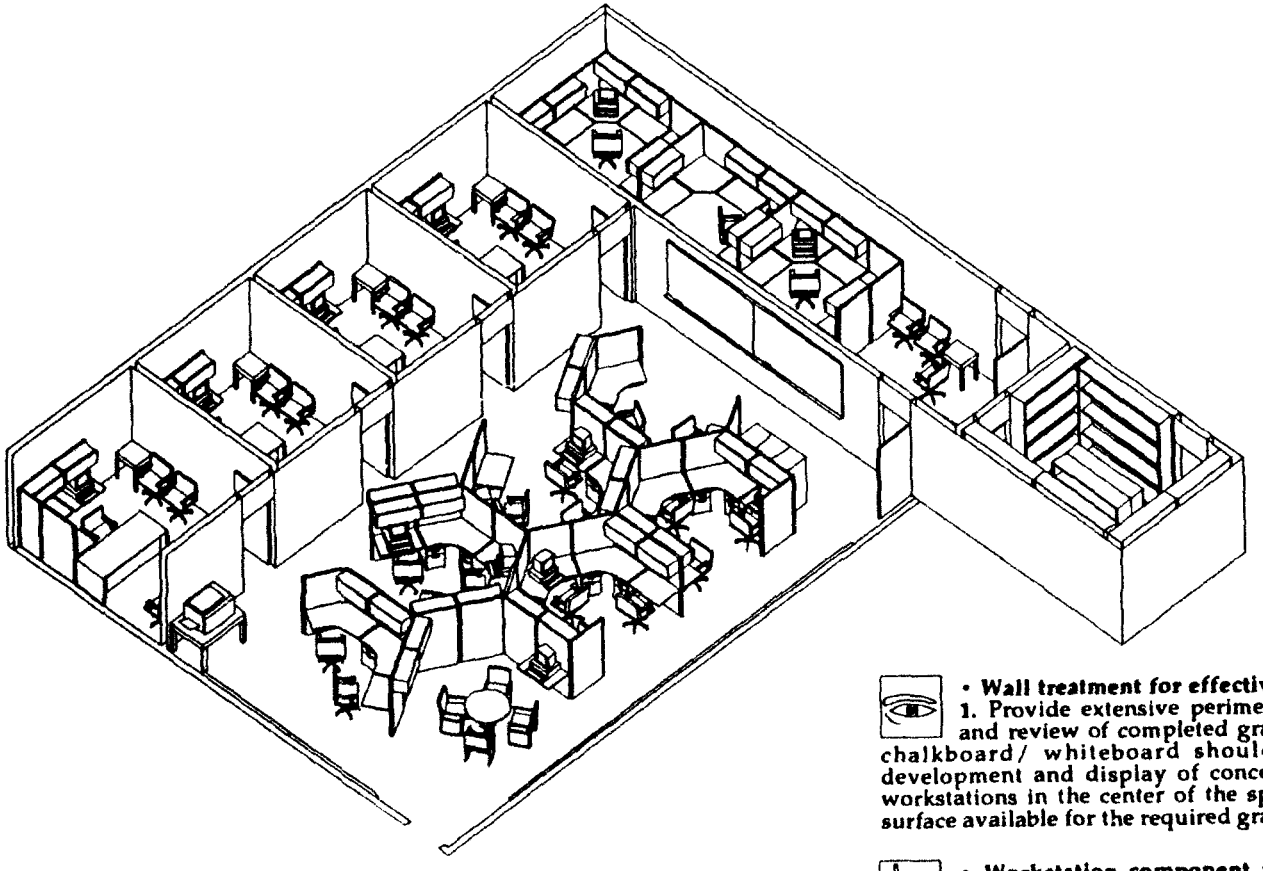
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2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.

• Acceptable travel distance to the nearest building exit during a fire:
1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)

• Optimal individual choice for the extent and location of the componentry in personnel workstation modules:
1. Provide personnel workstations using system furniture componentry with a single modular dimension of 36". This allows for:
a. easy rearrangement of all components since they will always be compatible with each other.
b. easy removal of individual desk unit components to accommodate floor-mounted equipment, and then the possible replacement of desk units when the equipment is eventually developed as desktop models. Personnel workstations using system furniture 36" components can be configured as either rectangular or hexagonal modules. The hexagonal modules are recommended for this space.

• Optimal choice for the rearrangement of personnel workstation modules:
1. To maintain a responsive, efficient work environment, space management should be localized with the first supervisors. Local planning and management are needed to retain equitable space allocation, to maintain previously established standards, and to respond efficiently to changing situations.

guidance/facility component systems



• Adequate personnel workstation area and appropriate workstation locations:

1. Provide the action officer (AO) workstation furniture as a continuous counter without any kneehole constraints. This allows for:
   a. maximum amount of desk-type worksurface area available.
   b. maximum choice of where AO and equipment can be located and/or co-located, especially when additional AOs are required to augment the assigned personnel for short time periods.
2. Provide the AO system furniture workstations using a standard 36" module throughout. This allows for:
   a. easy rearrangement of all components since they will all always be compatible with each other.
   b. easy removal of individual desk unit components to accommodate floor-mounted equipment, and then the possible replacement of desk units when the equipment is eventually developed as desktop models.

• Effective separation and/or interconnectivity between personnel workstations:

1. Divider partitions between workstations should be 60 inches high (+/-4 inches) to provide visual privacy while occupants are seated and yet not be confining.
2. A number of divider partitions between workstations should be able to be opened or closed as required to allow for either direct personnel interaction when open or for visual privacy when closed. These convertible partitions are especially relevant for hexagonal workstation configurations since each module has party partitions with several adjacent modules.

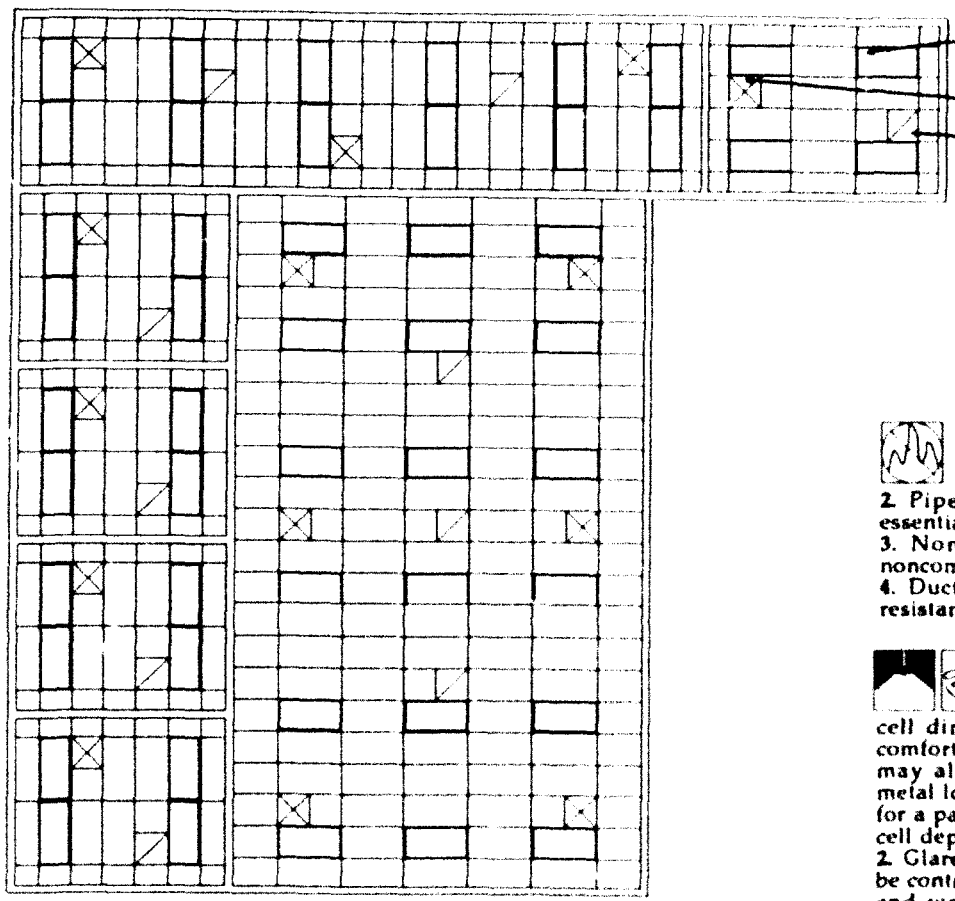
• Wall treatment for effective graphic displays:

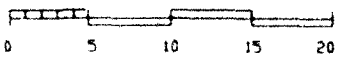
1. Provide extensive perimeter wall space to allow for the display and review of completed graphic displays. In addition, a 72" x 48" chalkboard/ whiteboard should be periodically provided for the development and display of conceptual ideas. Arranging the personnel workstations in the center of the space makes much of the perimeter wall surface available for the required graphic display and whiteboards.

• Workstation component and seating adjustability for effective ergonomic interaction.

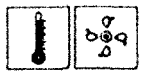
1. Seating for virtually all positions, clerical, computer operator, technician, and supervisory, should be of the type that is adjustable to a range of tasks and individual needs. Adjustments should include seat height, backrest height, seat pan tilt, and backrest angle.
2. Machine and computer keyboard surfaces are especially important in terms of adjustability -- height, slope, and angle. Video display terminals must be placed at the proper viewing height and angle, along with being adjustable for individual operator needs. Worksurfaces must be located at the proper height for the specified task and be adjustable to suit individual occupant requirements. Suggested surface heights include:
   a. working/writing surface: 26"-31".
   b. machine interaction surface: 24"-27".
   c. computer keyboard surface: 24"-30".

guidance/facility component systems





REFLECTED CEILING PLAN



• HVAC mechanical system to adequately accommodate electronic-generated heat loads:

1. Heat dissipation by computers, radios, and other electronic equipment is relatively constant; therefore, cooling is required year-round. The room sensible-heat ratio is near unity because heat generated by the computer system is all sensible.
2. The number of required air changes per hour should be 10 to 20 because of the equipment's high heat generation.
3. Humidity control is required year-round to maintain necessary conditions. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components.

• Optimal building mechanical system for equipment protection:

1. An independent air distribution system for electronic equipment spaces is needed.
2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.
3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall be used in electronic equipment cabinets.
4. Duct fire dampers shall be used in ducts that penetrate two-hour fire resistance-rated walls, partitions, shafts.

• Minimize reflected glare on VDT screens:

1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.



• Enable easy ceiling light fixture changes:

1. It is intended that there will be periodic changes in the location of personnel workstations. The ceiling fluorescent light fixtures must be installed in a manner to allow for any fixture unit to be moved to an adjacent ceiling grid module in any direction.



• Optimal acoustic conditions during high activity periods:

1. In order to provide the best working environment within operations spaces that can accommodate up to 30 or 40 persons at one time, it is suggested that the ceiling surface and available wall surface, where practical, be treated with sound-absorbing material. This treatment will allow for the maximum control of within-room noise levels.

Policy/SOP

Because of th. nature of the function of this space, it should be maintained in a reasonable state of readiness for the rapid assembly of personnel and information in a crisis situation. This space should be constructed and configured for the presentation of specified levels of classified information. Because this space is typically in use during both day-to-day and crisis operations, care must be taken to insure that no sensitive equipment is left exposed or no other secure portion of the command center is compromised.

S7
DIVISION CONFERENCE ROOM

function

For the presentation and dissemination of critical information that enables key personnel within the division to analyze and form decisions. This space should be available for periodic conferences and briefings during both day-to-day operations and crisis operations.

activities

1. Present information to key division personnel.
2. Analyze information.
3. Form decisions.
4. Communicate decisions and information to other appropriate organizations.

equipment

- Conference management table:
  (This table has space for the division heads with built-in information display terminals and communications support equipment).
- Ergonomic seating for 20
- Lectern with information display control panel and communication support equipment
- Full communications support:
  - Autovon
  - Commercial
  - Red Switch
  - Intercom
  - Teleconferencing
- Link with all applicable data systems
- Whiteboard/display surface
- Large-screen display system, rear-projection screens
- World clocks

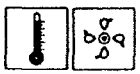
operations

1. Provides for the presentation of information relating to the Operations Division's mission, during both day-to-day and crisis operations.
2. Provides a central focal point for the management and control of the division's mission.
3. Provides real-time interaction with information displays.
4. Provides a communication link with other areas within the command center.

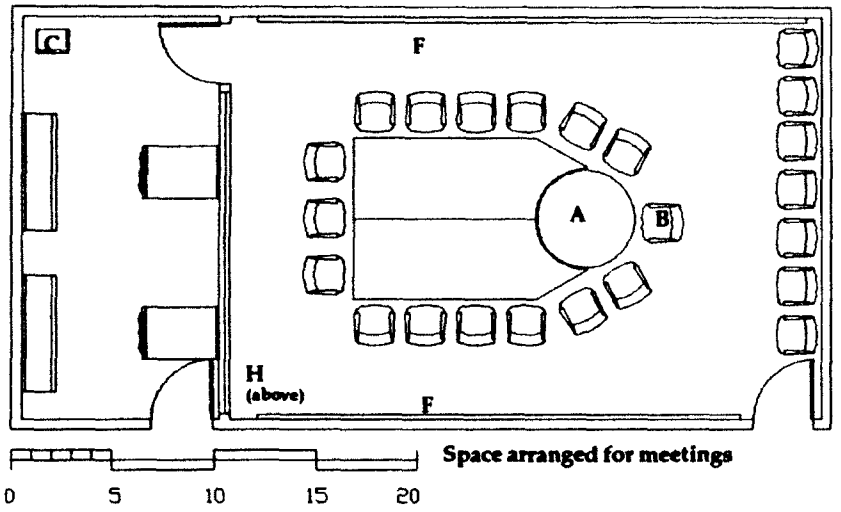
personnel

- Division heads
- 5-15 division personnel
- 1-2 briefers

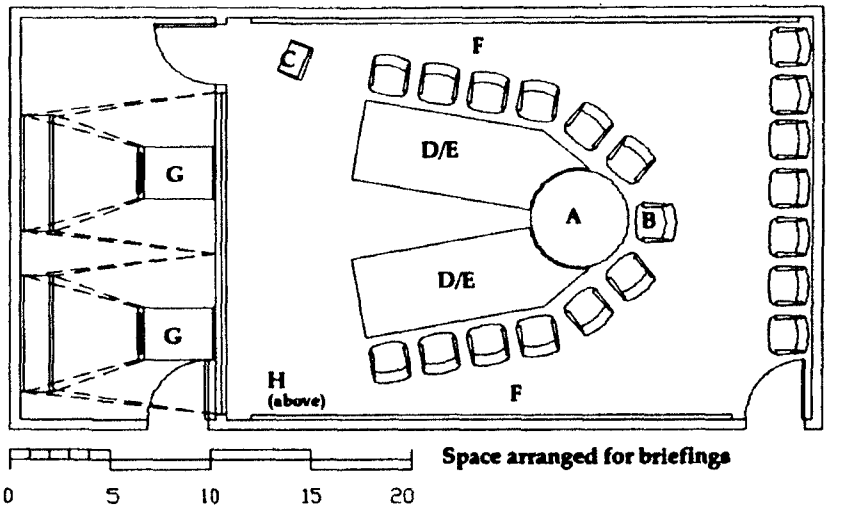
Division Conference Room S7-3

requirements	criteria	commentary
1. Enough space to accommodate the Operations Division briefing function and all support equipment.	1. The divisional conference room should be large enough to accommodate the division heads and selected key personnel, up to a maximum of 20 people. Space necessary for this purpose should be approximately 600 to 800 sq. ft., depending upon the type and amount of briefing display equipment and systems located within the space.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. Interior finishes suitable for durability, maintenance, and room function.	2. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	2.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
3. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	3. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise (NC) should be between NC 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	3.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
4. Comfort features for the occupant such as chair and furniture systems comfort.	4. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	4.  See Seating section in CCDH Volume 3 (page 7-5).
5. Adequate lighting.	5. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	5.  See Interior Lighting in CCDH Volume 3 (page 7-55).
6. Adequate climate control.	6. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	6.  See HVAC section in CCDH Volume 3 (page 7-65).
7. Accessible power outlets.	7. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall.	7. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
8. Fire protection/life safety.	8. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	8.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

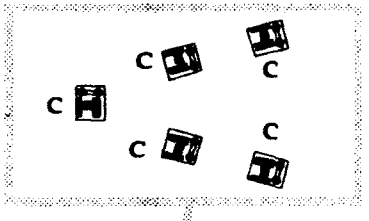
guidance/facility component systems



Space arranged for meetings

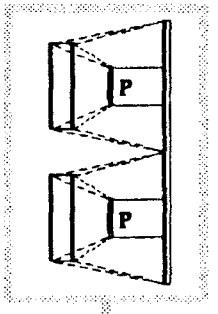


Space arranged for briefings



Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.
4. Access to multi-dimensional message service, including electronic mail and file transfers.

C= communications handset



Briefing and Display Subsystem Requirements:
1. Large-screen projection units, either rear-screen units in an adjacent room or self-contained units within the space.
2. Audio amplification system with interconnection to other watch and briefing spaces.

P= rear screen projector with mirror

Equipment List

A. Conference management table:
- **This table has space for the division heads with built in information display terminals and communications support equipment.**

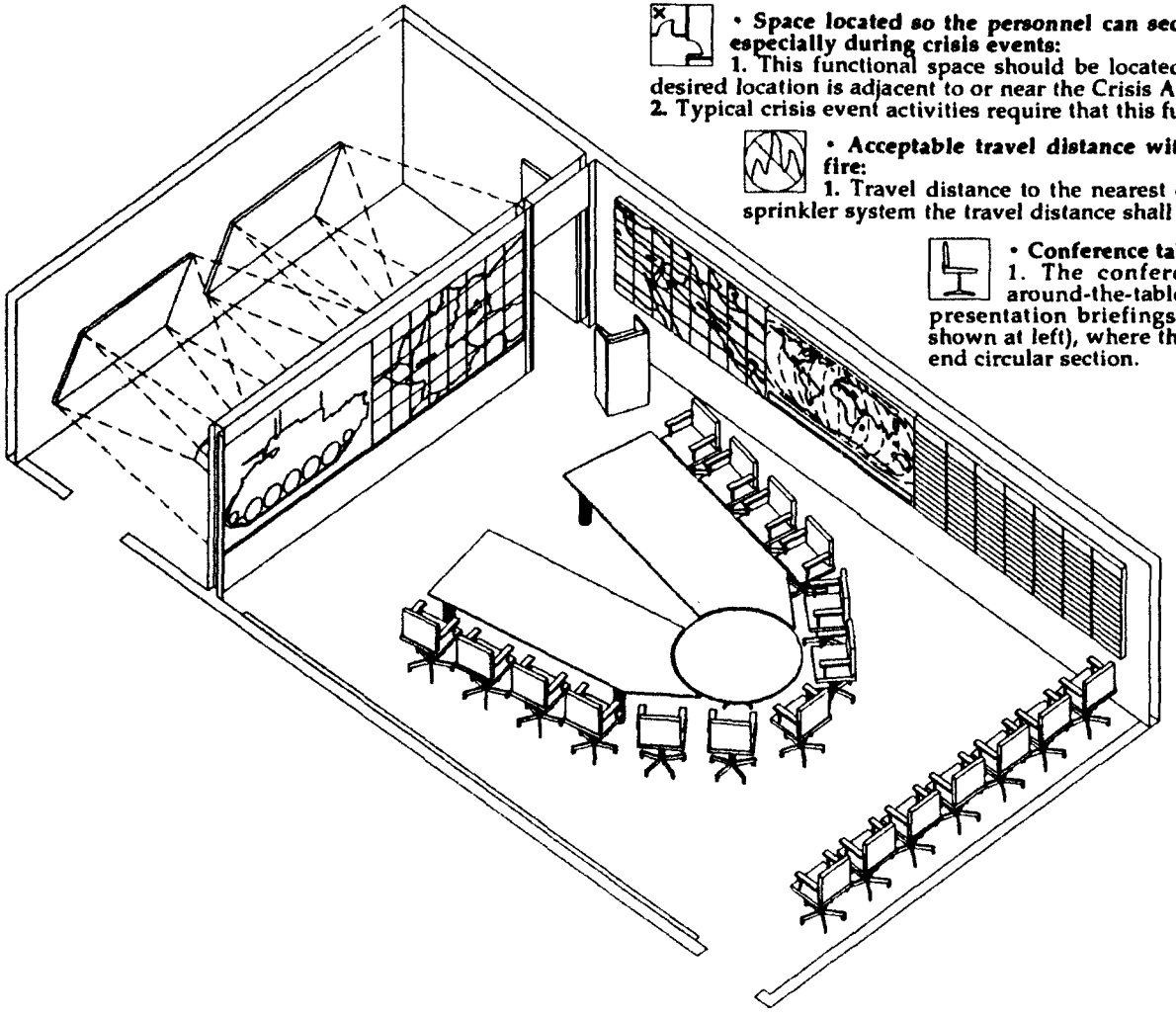
B. Ergonomic seating for 20
C. Lectern with information display control panel and communication support equipment
D. Full communications support
- **Commercial**
- **Autovon**
- **Red switch**
- **Intercom**
- **Teleconferencing**

E. Link with applicable information databases
F. Whiteboard/display surface
G. Large screen display system, rear projection screens
H. World clocks

- **Adequate size and quality of LSD images based on distance to primary viewers:**

1. Up to three large screen displays, with screen sizes 6 to 8 feet wide.
2. CRT LSD projectors offer highest performance/price tradeoff. For 6 to 8 foot wide displays, projectors employing 7 or 8 inch CRTs will provide adequate displays in a medium-to-low light level room. If rear-screen projection is not possible, consider self-contained projection units.)
3. Digital convergence projectors should be selected.

guidance/facility component systems



• **Space located so the personnel can securely and efficiently interact with others -- especially during crisis events:**
1. This functional space should be located within the core of a command center. The desired location is adjacent to or near the Crisis Action Team space.
2. Typical crisis event activities require that this functional space be located within a SCIF.

• **Acceptable travel distance within the space to the nearest door during a fire:**
1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)

• **Conference table modifiability:**
1. The conference table can be well-suited for both around-the-table discussion-type meetings and single-focus presentation briefings if it is made up of the three sections (as shown at left), where the two rectangular sections easily pivot on the end circular section.

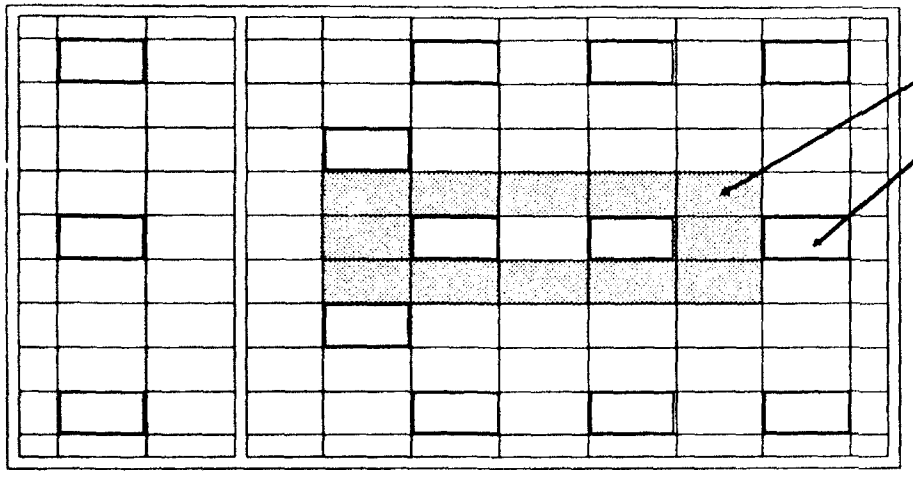
• **Adequate brightness of projected graphics:**
A rear-screen projector with a minimum output of 1000 lumens is recommended for an approximately eight-foot-wide image. Reducing the screen width to approximately six feet permits the use of projectors with a brightness of 600 lumens. WARNING: Large-screen projector images of highly detailed graphics may have limited legibility no matter how bright they are.

• **Room acoustic conditions determined by audio system designs:**
1. For meeting-type rooms a successful microphone/speaker system depends upon the surface treatment in the room itself. Both the floor and walls should be covered with sound-absorbing materials. The ceiling surface, however, should be reflective over

• **Coordination of graphic presentations by briefers:**
The briefers' lectern should contain the necessary communication connectivity to control the automated presentations and/or the necessary communication connection to those who do manual presentations. Such controls must be simple and obvious, since the briefers must primarily concentrate on text. (Ambient lighting controls should be on the room walls adjacent to the lectern rather than being on the lectern itself.)

• **Wall treatment for effective graphic displays:**
1. Provide extensive perimeter wall space to allow for the display and review of completed graphic displays. In addition, a 72" x 48" chalkboard/ whiteboard should be periodically provided for the development and display of conceptual ideas. Arranging the personnel workstations in the center of the space makes much of the perimeter wall surface available for the required graphic display and whiteboards.

guidance/facility component systems



REFLECTED CEILING PLAN

• Optimal building mechanical system for equipment protection:
1. An independent air distribution system for electronic equipment spaces is needed.
2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.
3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall be used in electronic equipment cabinets.
4. Duct fire dampers shall be used in ducts that penetrate two-hour fire resistance-rated walls, partitions, shafts.

• Impact of HVAC system noises on acoustical conditions:
Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.

• Acceptable travel distance to the nearest building exit during a fire:
1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)

• Minimize reflected glare on VDT screens:
1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

Policy/SOP

Individual command center policy will dictate the need for the involvement of other agencies and their representatives. When agency representatives are required to support the command center mission, space and administrative support will be allocated based upon the tasks assigned to the representative and the rank or equivalent rank of the representative in relation to the command center personnel structure.

NOTE:

Agencies that may play a support role at the various command centers include, but are not limited to, the following:

Defense Intelligence Agency (DIA)
Central Intelligence Agency (CIA)
National Security Agency (NSA)
Defense Information System Agency (DISA)
Others as appropriate

Space and workstations must be provided within the command center and in the Current Actions Center and Battle Staff Support Center where applicable.

S8
AGENCY SUPPORT AREA

function

For the clear coordination of situations requiring support of other government and DoD agencies outside of the specified command center and the accommodation of a designated representative for each of the appropriate agencies.

activities

1. Receive requests for agency support.
2. Monitor situation as necessary.
3. Prepare information briefings.
4. Communicate with other agency elements.
5. Provide input to command center Crisis Action Team as required.
6. Access the appropriate information databases.
7. Store classified material as required.

equipment

- Agency representative workstation:
  - Worksurface with storage
  - Ergonomic chair
  - 2 visitor's chairs
  - File cabinet(s)
  - Bookcases
  - Whiteboard
  - Link with all required data bases
- Secretarial workstation:
  - Worksurface with storage
  - Typing surface
  - VDT surface
  - Printer stand
  - File cabinets
  - Ergonomic chair
- 2 visitor's chairs
- Supply storage cabinets
- Classified material containers
- Conference area:
  - Conference table
  - Seating for 6-8
  - Whiteboard
- Full communications support:
  - Autovon
  - Commercial
  - Red switch
  - Intercom
  - Teleconferencing

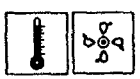
operations

1. Provide support to the day-to-day operations in the Current Action Center.
2. Provide support during a crisis situation to the Crisis Action Team in the Battle Staff Support Center.
3. Provide a communications and information link between the command center and the designated agency.
4. Provide input as needed to the Senior Battle Staff during command briefings and decision making processes.
5. Provide briefings as necessary.

Note:
If the agency support section consists of individual representatives from a number of agencies, it may be feasible to locate them together in a single suite of offices or workstations which could then share a common conference area and secretary or secretarial pool.

personnel

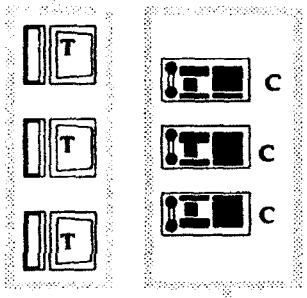
- Agency representative
- Secretary (as required) --see note in Operations

requirements	criteria	commentary
1. Enough space to accommodate the furnishings and equipment agency representative(s) and any required secretarial/clerical support.	1. The space required will depend upon the number of agency representatives assigned. Typically, an O6 Military or GS 15 level person will be allocated an area of about 200 sq. ft. The secretarial area shall accommodate the secretarial workstation, a small reception area, storage and filing space, classified material storage (if required), and any VDT/printers associated with the secretarial/clerical tasks. The Agency Support Area, consisting of 4 agency representatives, one secretary, and a small conference area, would require approximately 1100 sq. ft.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. Interior finishes suitable for durability, maintenance, and room function.	2. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	2.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
3. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	3. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise (NC) should be between NC 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	3.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
4. Comfort features for the occupant such as chair and furniture systems comfort.	4. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	4.  See Seating section in CCDH Volume 3 (page 7-5).
5. Adequate lighting.	5. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	5.  See Interior Lighting in CCDH Volume 3 (page 7-55).
6. Adequate climate control.	6. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	6.  See HVAC section in CCDH Volume 3 (page 7-65).
7. Accessible power outlets.	7. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall.	7. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
8. Fire protection/life safety.	8. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	8.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

guidance/facility component systems

Information Processing Subsystem Requirements:
1. Local Area Network (LAN) with appropriate software capabilities to support immediate data retrieval for decision-makers.

T= computer terminal



Communication Subsystem Requirements:
1. Access to required external systems, such as AFSATCOM, AUTODIN, AUTOVON, JCSAN, ARPCA and HF radios.
2. Access to required internal systems.
3. Observance of protective criteria for red/black and TEMPEST.
4. Access to multi-dimensional message service, including electronic mail and file transfers.
5. Access to internal and external facsimile connections that have multi-level-security.

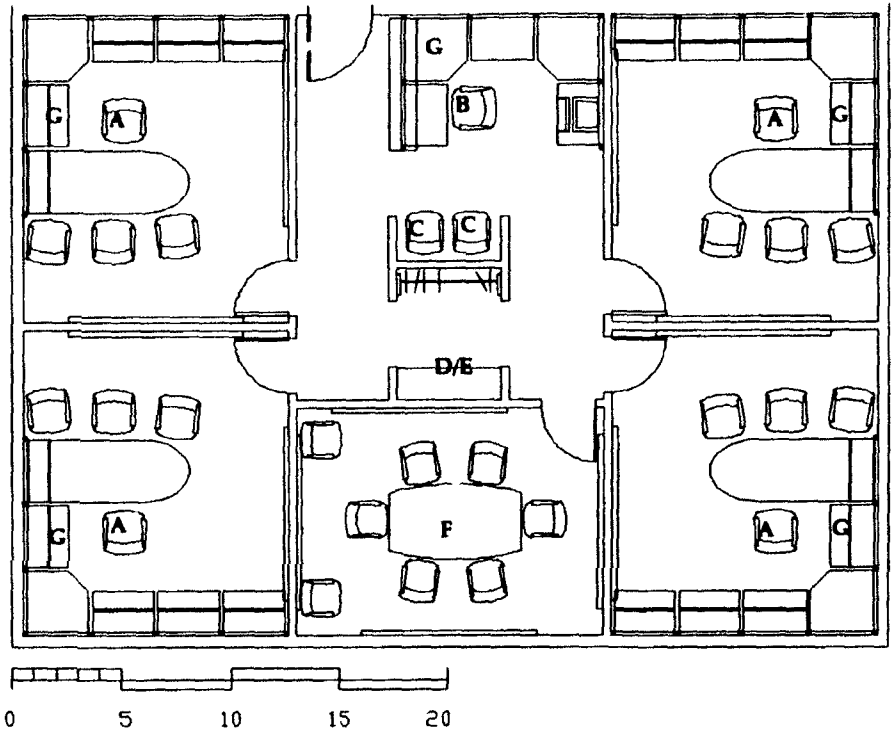
C = communications handset

• Optimum interoperability of the LAN:
1. In order to take advantage of the IPS currently available, the commands' LAN system will require a UNIX-based platform, and should be compliant with GOSIP, X Window, and Motif standards.
2. AO's connected to the command LAN require terminals similar to UNIX-based integrated workstations.
3. In order to support operations, the LAN requires several laser printers with a minimum of 2 MB of random access memory (RAM).

• Adequate facsimile capability:
1. Provide both non-secure and secure facsimile machines with at least one spare machine available at each level.
2. Tie in the FAX capability with the LAN system to take advantage of LAN scanner, printers, etc.

• Adequate numbers and quality of the secure/nonsecure telephone units:
1. Calls to the telephones of key local and distant individuals are established within 10 seconds or less.
2. Voice clarity over all communication paths is equivalent to STU-111 clarity or better.
3. Provide "precedence" capability to assure the most important C3 messages get through first.

• Adequate numbers and quality of computer terminals:
1. Necessary types of information (e.g.,messages, maps, TV news) can be sent and received.
2. Undetected data errors are negligible.
3. A computer file that is needed quickly (e.g., a photo) can be delivered electronically within one minute to destinations inside the command center and within 10 minutes to remote destinations.



Equipment List

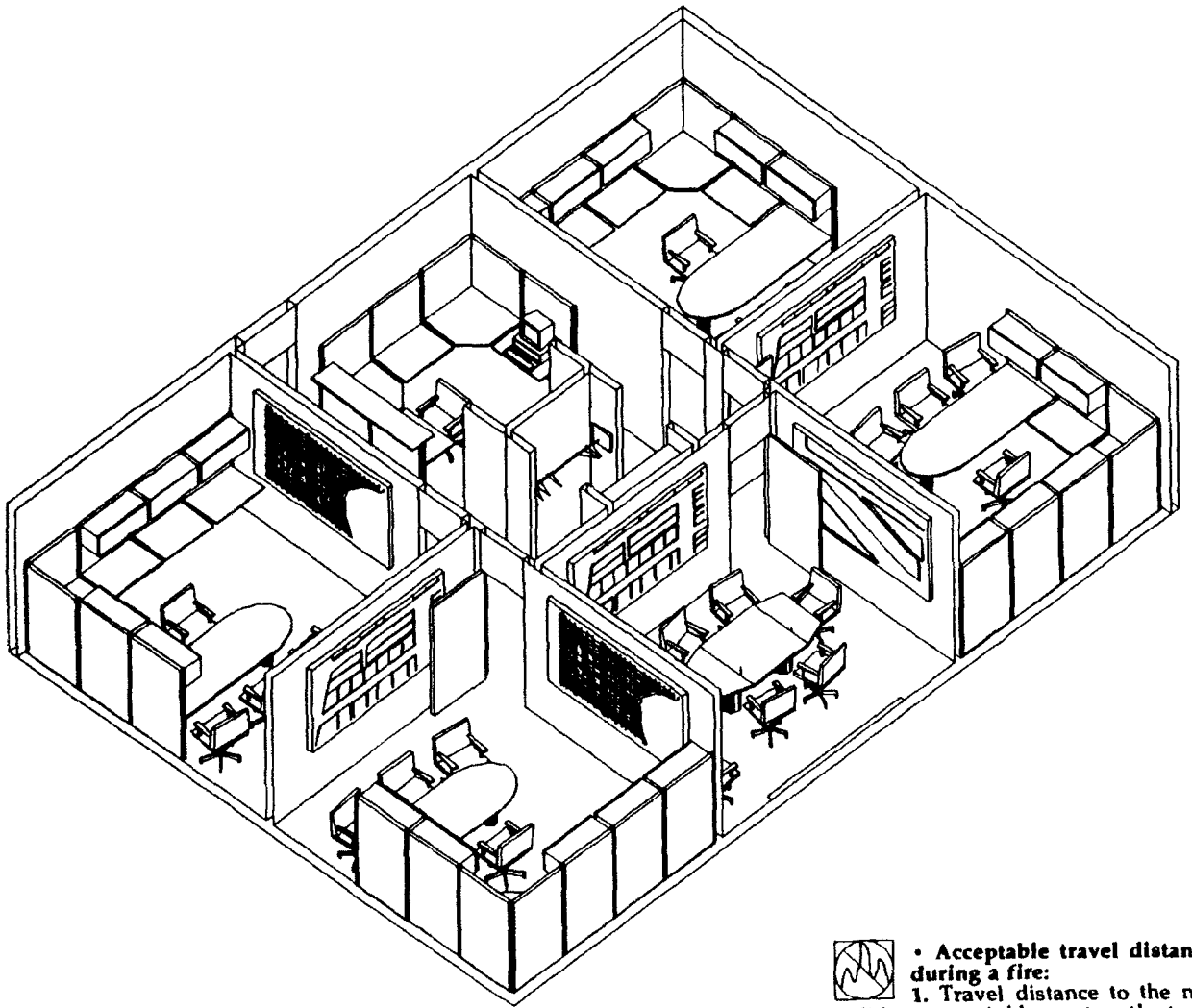
A. Agency Representative workstation:
- Worksurface with storage
- Bookshelve(s)/file cabinet(s)
- Ergonomic chair(s)
- 2 visitor's chairs
- Whiteboard
- Link with applicable information databases

B. Secretarial workstation:
- Worksurface with storage
- Bookshelve(s)/file cabinet(s)
- Ergonomic chair(s)
- Typing surface
- VDT surface
- Printer stand

C. 2 visitor's chairs
D. Supply storage cabinets
E. Classified material container(s)
F. Conference area:
- Conference table
- Seating for 6-8
- Whiteboard

G. Full communication support
- Commercial
- Autovon
- Red switch
- Intercom
- Teleconferencing

guidance/facility component systems

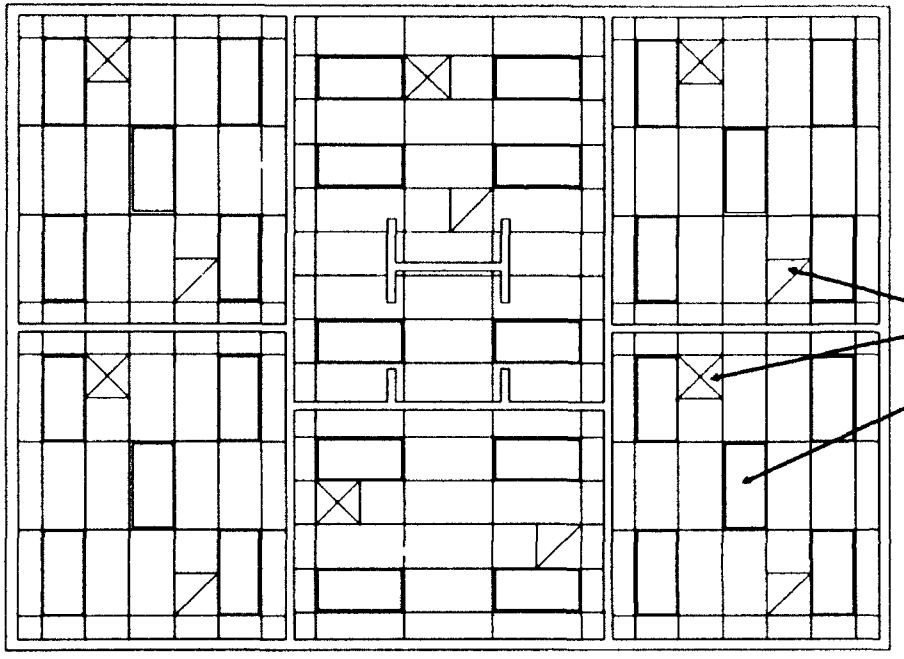


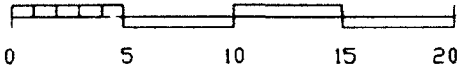
• Wall treatment for effective graphic displays:
1. Provide extensive perimeter wall space to allow for the display and review of completed graphic displays. In addition, a 72" x 48" chalkboard/ whiteboard should be periodically provided for the development and display of conceptual ideas. Arranging the personnel workstations in the center of the space makes much of the perimeter wall surface available for the required graphic display and whiteboards.

• Acceptable travel distance within the space to the nearest door during a fire:
1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)
2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.

• Acceptable travel distance to the nearest building exit during a fire:
1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)

guidance/facility component systems





REFLECTED CEILING PLAN



• **Impact of HVAC system noises on acoustical conditions:** Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.

Policy/SOP

The ADP Operations area must operate continuously on a 24-hour basis with no down time. Due to the nature of the ADP Operations area, security measures in accordance with established command center policy shall be followed. Only those personnel with the proper security clearances will be allowed unescorted into the area. All others must be cleared and escorted through the area following a sanitizing of the area. Equipment must be maintained in accordance with manufacturers' schedules. Spare parts and systems shall be on hand to allow for a rapid repair or transfer in the event of an equipment or system failure.

Note:

Standard operational procedure in many command centers calls for the use of contracted maintenance personnel for the maintenance and repair of ADP equipment. The total number of supervisory and technical maintenance personnel required in this area will be dependent upon existing contractual arrangements.

S9
ADP AREA/ COMPUTER OPERATIONS CENTER

rev. Sept. '91

function

For the maintenance, operation, and technical support of all computer hardware and software in use throughout the center in support of the overall mission of the command center.

operations

1. Provide technical support for the command center's computer system.
2. Provide maintenance capability for equipment.
3. Provide storage and maintenance of the software documentation library.
4. Provide for uninterrupted operation of the command center computer system, e.g., WWMCCS, WIN.
5. Provide an inventory of spare parts for maintenance and repair.
6. Provide a preventive maintenance program for the primary computer system and any redundant systems.
7. Provide a security plan for the physical security of the ADP Operations Area and a plan for the security of the information databases.

notes

COMPUTER OPERATIONS ROOM

activities

1. Monitor operation of computer system.
2. Isolate any system malfunctions.
3. Identify points of system or equipment failure.
4. Complete any minor system or equipment repair.
5. Prioritize processing requests.
6. Maintain operations log.
7. Prepare reports and/or briefings concerning computer operations.

personnel

1 computer operator (per shift)
2-4 computer technicians (per shift)

equipment

- Computer operations console with communications support and technician work area:
  - Worksurface with storage
  - Reference shelving
  - Ergonomic chair
- Additional computer equipment:
  - Central processing units
  - Disk drives
  - Tape drives
  - Printers
  - Plotters
  - Communication links
- The exact listing and space required by all computer equipment will depend upon the type and capacity of the system at the specified command center.

rev. Sept. '91

NCO/NCOIC OFFICE

activities

1. Administer/supervise computer operations area.
2. Prepare systems status reports.
3. Provide systems status information as required.
4. Provide training of new personnel as needed.

personnel

- 1 NCO
- 1 NCOIC

equipment

- NCOIC office:
  - Desk with storage
  - File cabinet
  - Reference shelving
  - 2 visitor's chairs
  - Whiteboard
  - Ergonomic chair
- NCO workstation:
  - Worksurface with storage
  - Machine surface
  - Terminal with printer
  - File cabinet
  - 1 visitor's chair
  - Ergonomic chair

MAINTENANCE/PARTS/MANUFACTURER'S REPRESENTATIVE'S AREA

activities

1. Repair computer equipment.
2. Store repair parts.
3. Receive parts.
4. Inspect and perform diagnostic testing of equipment.
5. Complete repair and maintenance reports.

personnel

- 1 maintenance NCOIC
- 2-3 maintenance technicians (per shift)

equipment

- Maintenance/NCOIC workstation:
  - Worksurface with storage
  - Reference shelving
  - File cabinet
  - Terminal
  - Printer
  - Ergonomic chair
- Maintenance technician workstation:
  - Worksurface with storage
  - Reference shelving
  - Ergonomic chair
- Parts storage shelving and parts bins
- Workbenches for technicians and manufacturers' representatives
- Stools
- Reference and repair manual library
- Tool storage
- Repair status scheduling board
- Secure storage for electronic diagnostic equipment
- Shared terminal

TAPE LIBRARY

activities

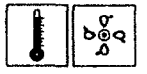
1. Maintain computer tapes and disks.
2. Store computer tapes and disks.
3. Maintain and update library records.
4. Receive incoming material.
5. Prepare material for shipping.
6. Store labeling, maintenance, and shipping supplies.
7. Retrieve requested disks and tapes.

personnel

- 1 maintenance NCOIC
- 2-3 maintenance technicians (per shift)

equipment

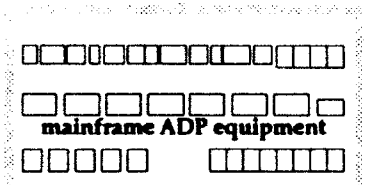
- Librarian workstation:
  - Worksurface with storage
  - Reference shelving
  - Terminal with printer
  - 1 visitor's chair
  - Ergonomic chair
- Technician workbench
- Stools
- Reference manual shelving
- Shared terminal
- 100-150 linear feet of 4 to 5 tier tape and disk storage units (Approximately 30-50 individual cabinets)
- *File cabinet*
- Telephone/intercom
- *Wall scheduling board*

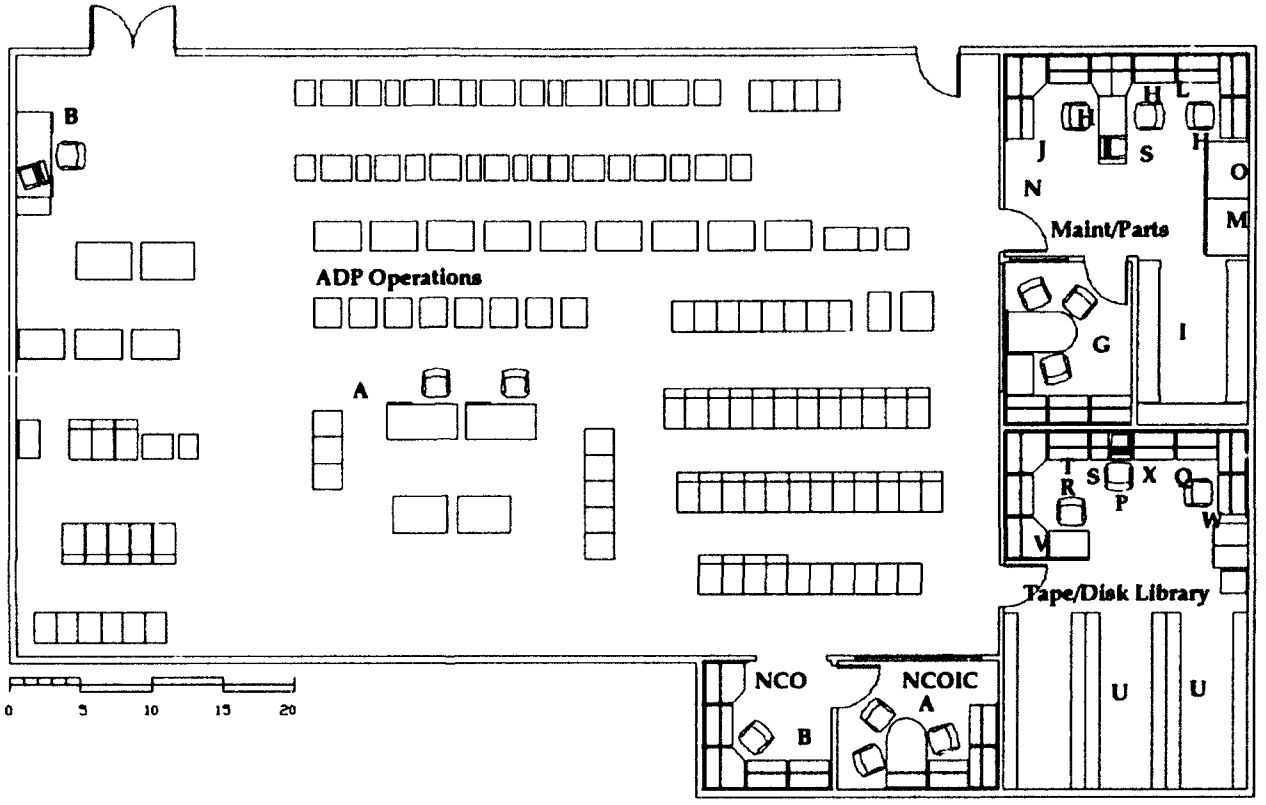
requirements	criteria	commentary
1. Enough space to accommodate the equipment and personnel associated with the ADP operation area and necessary to support the command center mission.	1. Space shall be provided for the smooth operation, administration, and maintenance of the command center ADP area. This series of spaces may be reallocated or further subdivided to meet the needs of the individual command center. Space has been apportioned in four general areas as follows: ADP Operations Room 3000 sq. ft. NCO/NCOIC Office 200 sq. ft. Maintenance/Parts/Manufacturer's Representatives 400 sq. ft. Disk/Tape Library 400 sq. ft.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. A secure environment for the monitoring of sensitive/critical information during crisis and non-crisis situations.	2. The ADP/Computer Ops Area shall be located within the facility so that discussion and presentation of sensitive material in the space cannot be compromised. The access to the space must be controlled so no one may enter without proper clearance. All appropriate equipment in the space must be TEMPEST certified.	2.  See TEMPEST section of the Security Systems in CCDH Volume 3 (page 7-33).
3. Interior finishes suitable for durability, maintenance, and room function.	3. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	3.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
4. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	4. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise should be between (NC) 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	4.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
5. Comfort features for the occupant such as chair and furniture systems comfort.	5. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	5.  See Seating section in CCDH Volume 3 (page 7-5).
6. Adequate lighting.	6. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	6.  See Interior Lighting in CCDH Volume 3 (page 7-55).
7. Adequate climate control.	7. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	7.  See HVAC section in CCDH Volume 3 (page 7-65).
8. Accessible power outlets.	8. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall. Provide a raised floor system that allows for easy access to power connections away from the walls.	8. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
9. Fire protection/life safety.	9. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	9.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

guidance/facility component systems

Information Processing Subsytem Requirements:

T= computer terminal





Equipment List

A. Computer operations console with communications support and ergonomic seating
B. Technician work area:
- Worksurface with storage
- Bookcase(s)
- Ergonomic chair(s)

C. Other computer equipment required in this space:
- Central processing units
- Disk drives
- Tape drives
- Printers
- Plotters
- Communication links

D. The exact listing and space required by all computer equipment will depend upon the type and capacity of the system at the specified command center.
E. NCOIC office:
- Desk with storage
- Bookcase(s)/filecabinet(s)
- Ergonomic chair(s)
- 2 visitor's chairs
- Whiteboard

F. NCO workstation:
- Ergonomic chair(s)
- Machine surface
- Terminal w/printer
- File cabinet
- 1 visitor's chair
- Ergonomic chair(s)

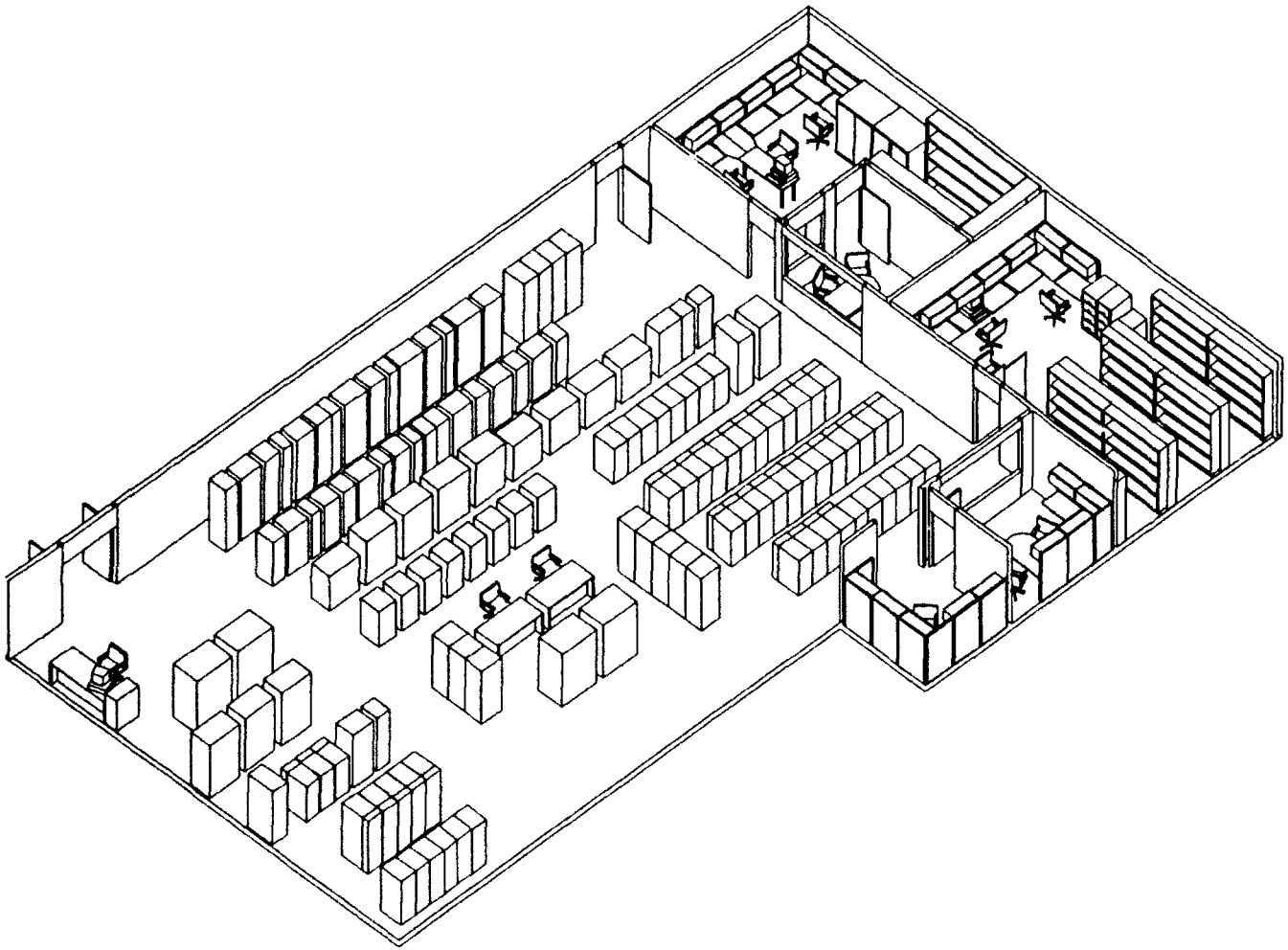
G. Maintenance NCOIC workstation:
- Worksurface with storage
- Bookcase(s)/filecabinet(s)
- Ergonomic chair(s)
- Terminal
- Printer

H. Maintenance technician workstation:
- Worksurface with storage
- Bookcase(s)
- Ergonomic chair(s)

I. Parts storage shelving and parts bins.
J. Workbenches for technicians and manufacturers' representatives
K. Stools
L. Reference and repair library
M. Tool storage
N. Repair status scheduling board
O. Secure storage for electronic diagnostic equipment
P. Shared terminal
Q. Librarian workstation:
- Worksurface with storage
- Bookcase(s)
- Ergonomic chair(s)
- Terminal with printer
- 1 visitor's chair

R. Technician workbench
S. Stools
T. Reference manual shelving
U. 100-150 linear feet of 4 to 5 tier tape and disk storage units (Approx. 30-50 individual cabinets)
V. File cabinet
W. Telephone/intercom
X. Wall scheduling board

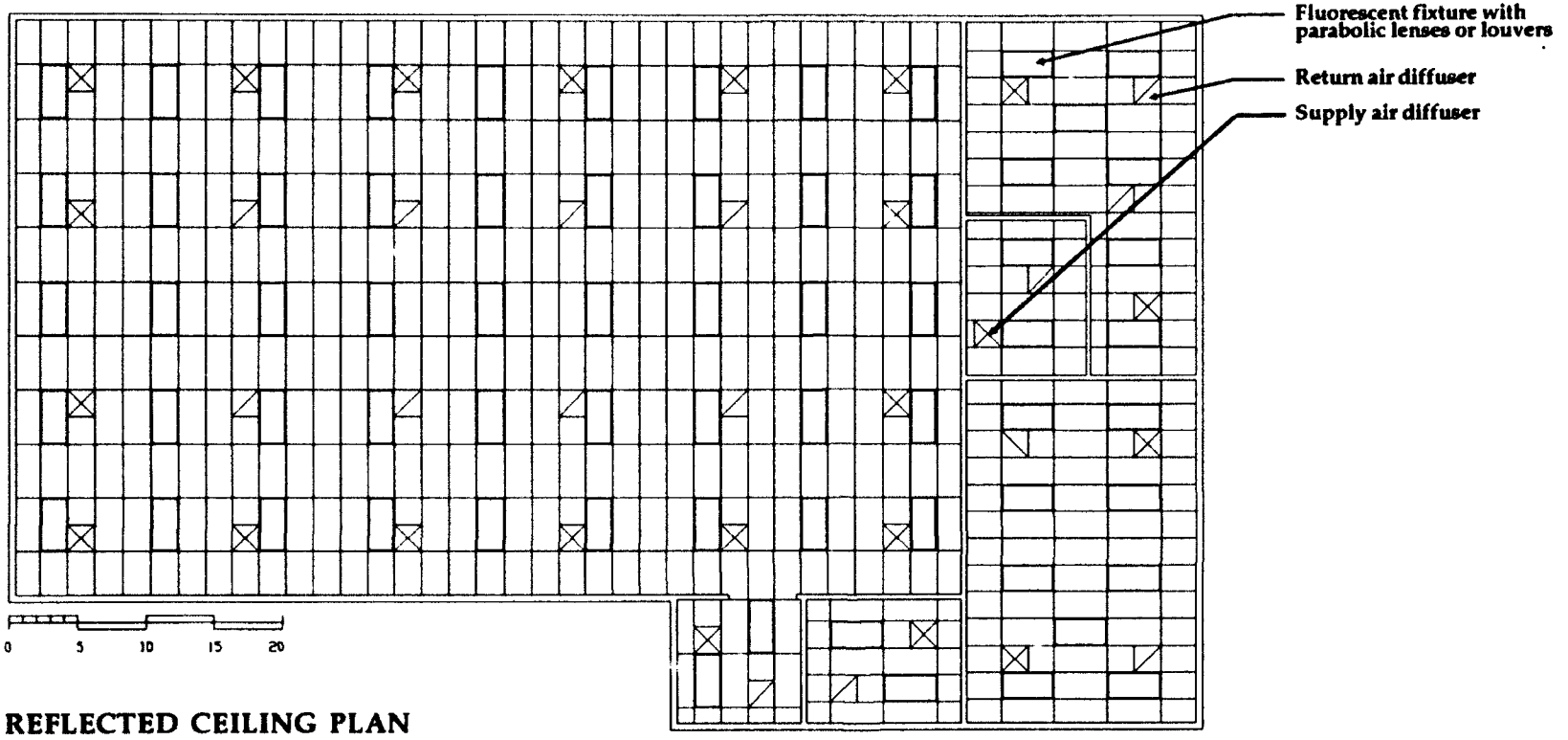
guidance/facility component systems



• Acceptable travel distance within the space to the nearest door during a fire:
1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)
2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.

• Acceptable travel distance to the nearest building exit during a fire:
1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)

guidance/facility component systems



REFLECTED CEILING PLAN

• HVAC mechanical system to adequately accommodate electronic-generated heat loads:

1. Heat dissipation by computers, radios, and other electronic equipment is relatively constant; therefore, cooling is required year-round. The room sensible-heat ratio is near unity because heat generated by the computer system is all sensible.
2. The number of required air changes per hour should be 10 to 20 because of the equipment's high heat generation.
3. Humidity control is required year-round to maintain necessary conditions. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components.

• Optimal building mechanical system for equipment protection:

1. An independent air distribution system for electronic equipment spaces is needed.
2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.
3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall be used in electronic equipment cabinets.
4. Duct fire dampers shall be used in ducts that penetrate two-hour fire resistance-rated walls, partitions, shafts.

Policy/SOP

Command center policy will indicate the level of personnel allowed in this area. This space shall be controlled and clearance secure to the same level as the space it serves.

S10
PROJECTION ROOM

rev. Sept. '91

function

For the rear-screen video projectors used in presenting information for training or command decisions.

activities

1. Maintenance of equipment.

equipment

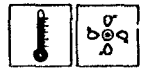
- Large-screen video projectors as required with supports
- Spare parts cabinet
- Patch panel
- Worksurface for servicing

operations

1. Provide large-screen video projectors.
2. Provide for scheduled maintenance of equipment.

personnel

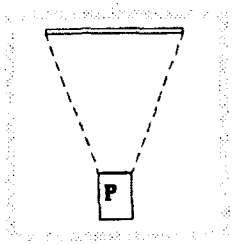
None full time; periodically a person is assigned for major presentation, but usually equipment operates by remote control without supervision.

requirements	criteria	commentary
1. Enough space for the number of projectors and easy servicing.	1. Space varies with the room served and the number and size of screens required.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. Security.	2. Projection facilities must be secure to the same level as the space they serve.	2.  See TEMPEST section of the Security Systems in CCDH Volume 3 (page 7-33).
3. Interior finishes suitable for durability, maintenance, and room function.	3. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Base*** Vinyl or comparable resilient material.	3.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
4. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	4. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise should be between (NC) 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	4.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
5. Comfort features for the occupant such as chair and furniture systems comfort.	5. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	5.  See Seating section in CCDH Volume 3 (page 7-5).
6. Adequate lighting.	6. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	6.  See Interior Lighting in CCDH Volume 3 (page 7-55).
7. Adequate climate control.	7. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	7.  See HVAC section in CCDH Volume 3 (page 7-65).
8. Accessible power outlets.	8. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall.	8. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
9. Fire protection/life safety.	9. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	9.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

guidance/facility component systems

Briefing and Display Subsystem Requirements:
1. Large-screen projection units, either rear-screen units in an adjacent room or self-contained units within the space.

P= rear screen projector



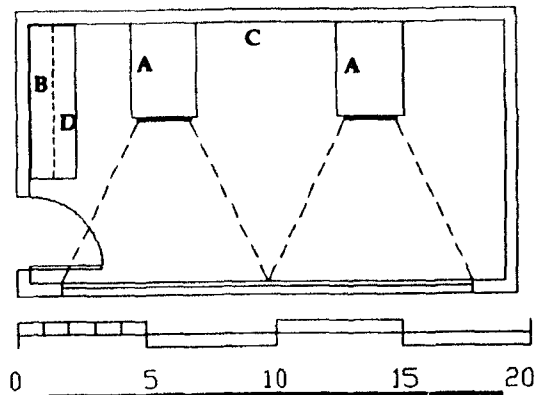
• **Maintain equal image quality on large-screen displays:**
1. In order that large-screen briefing display images have equal brightness, contrast, and resolution characteristics, provide identical projectors and screens.
2. Digital convergence projectors should be selected.
3. Projector screens with gain between 1 and 3 required for high-resolution images.

• **Maintain consistent image quality for both small-screen monitors and large-screen projectors:**
1. Use high-bandwidth video distribution amplifiers (100 Megahertz) to duplicate large-screen images on monitors.
2. High quality video decoders will improve the LS display of TV signals (NBC,ABC,CBS,CNN).

• **Adequate brightness of projected graphics:**
1. A rear-screen projector with a minimum output of 1000 lumens is recommended for an approximately 8-foot wide image. Reducing the screen width to approximately 6 feet permits the use of projectors with a brightness of 600 lumens. **Warning**: Large-screen projector images of highly detailed graphics may have limited legibility no matter how bright they are.

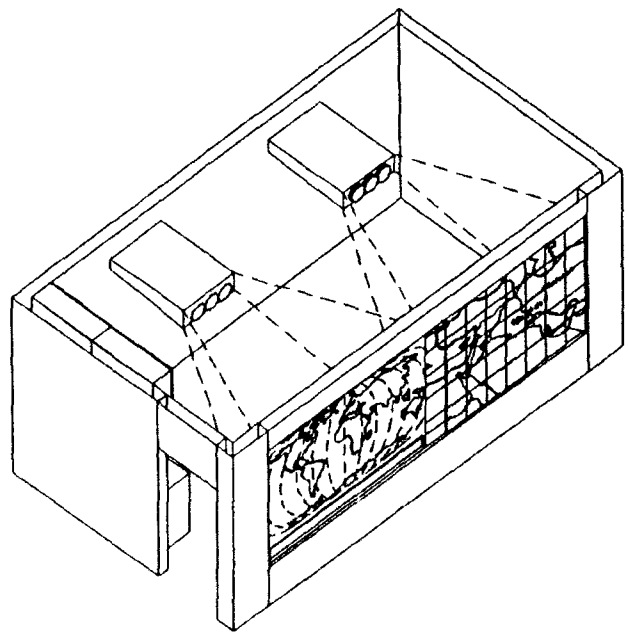
• **Adequate size and quality of LSD images based on distance to primary viewers:**
1. Up to four large screen displays with screen sizes 8 to 12 feet wide.
2. CRT LSD projectors offer highest performance/price tradeoff. Screen sizes from 8 to 10 feet in width employing 8 or 9 inch CRTs can provide adequate displays in a medium-to-low light level room. Projectors employing light-valve technology should be considered for display widths of 10 to 12 feet.

• **Adequate brightness of projected graphics:**
A rear-screen projector with a minimum output of 1000 lumens is recommended for an approximately eight-foot-wide image. Reducing the screen width to approximately six feet permits the use of projectors with a brightness of 600 lumens. WARNING: Large-screen projector images of highly detailed graphics may have limited legibility no matter how bright they are.



Equipment List

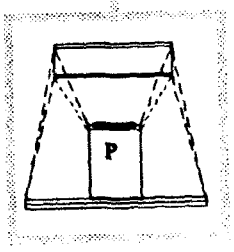
A. Large-screen video projectors as required with supports
B. Spare parts cabinet
C. Patch panel
D. Worksurface for servicing



guidance/facility component systems

Briefing and Display Subsystem Requirements:
1. Large-screen projection units, either rear-screen units in an adjacent room or self-contained units within the space.

P= rear screen projector with mirror



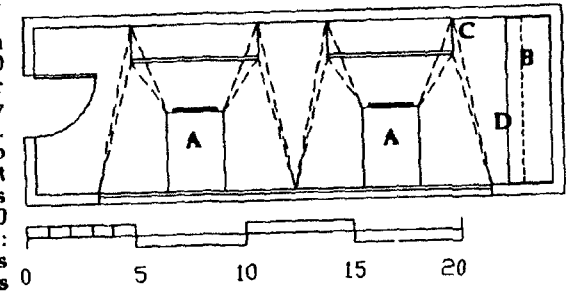
• **Maintain equal image quality on large-screen displays:**
1. In order that large-screen briefing display images have equal brightness, contrast, and resolution characteristics, provide identical projectors and screens.
2. Digital convergence projectors should be selected.
3. Projector screens with gain between 1 and 3 required for high-resolution images.

• **Maintain consistent image quality for both small-screen monitors and large-screen projectors:**
1. Use high-bandwidth video distribution amplifiers (100 Megahert:.) to duplicate large-screen images on monitors.
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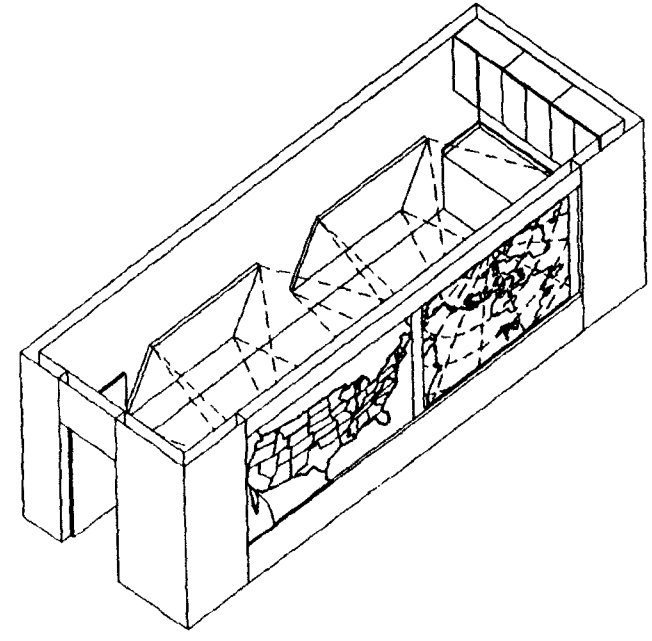
• **Adequate size and quality of LSD images based on distance to primary viewers:**
1. Up to four large screen displays with screen sizes 8 to 12 feet wide.
2. CRT LSD projectors offer highest performance/price tradeoff. Screen sizes from 8 to 10 feet in width employing 8 or 9 inch CRTs can provide adequate displays in a medium-to-low light level room. Projectors employing light-valve technology should be considered for display widths of 10 to 12 feet.

• **Adequate brightness of projected graphics:**
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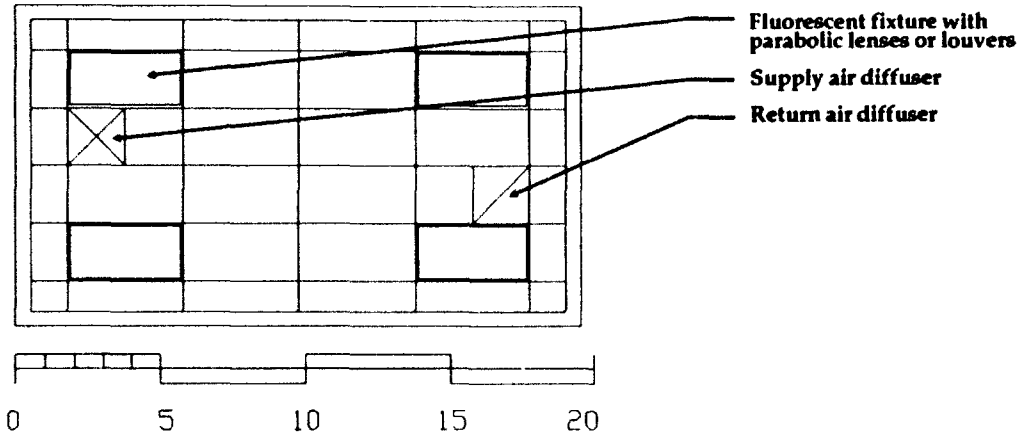


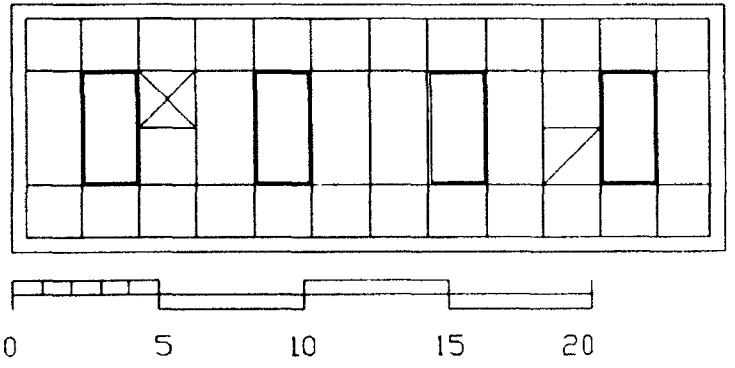
Equipment List

A. Large-screen video projectors as required with supports
B. Spare parts cabinet
C. Patch panel
D. Worksurface for servicing



guidance/facility component systems





REFLECTED CEILING PLANS

Policy/SOP

Due to the sensitive nature of material routed through the TV Studio/Visual Recording Facility, it shall function at the SCI (Secure Compartmented Information) level. The VRF shall be maintained in a constant state of readiness for activation.

S11
TV STUDIO/ VISUAL RECORDINGS FACILITY

function

To serve as a functional link between graphics production and information display screens by converting graphics or other information to video/audio signals for routing to appropriate conference screens. For developing information in the form of graphics, film, video, or live presentations.

activities

1. Monitor conferences to control switching of graphic displays.
2. Record and edit program material.
3. Monitor equipment.
4. Maintain equipment.

equipment

- Control console/routing switcher (1-3 people):
  - Worksurface
  - Ergonomic chairs
  - Control panels
  - Video monitors
  - Audio monitors
- Control console for remote presentations
- Equipment racks
- Suspended lighting support
- Film chain with:
  - 8 35mm slide projectors
  - 1 70mm slide projector
  - 4 vu-graph projectors
  - 1 16mm movie camera
- Splicing/rewind work table
- Equipment storage
- Tack boards
- Drapes
- Video cameras
- Presentation seating
- Graphic/slide storage
- Flat drawer storage
- Graphics inventory and records management computer

operations

1. Provide for the conversion of graphic, film, or live presentation to video signals.
2. Provide for the control and routing of video signals to conference screens.
3. Provide communications links with conference rooms.
4. Provide limited studio facilities for video conferencing or remote briefings.
5. Provide for storage and destruction of graphic materials.

personnel

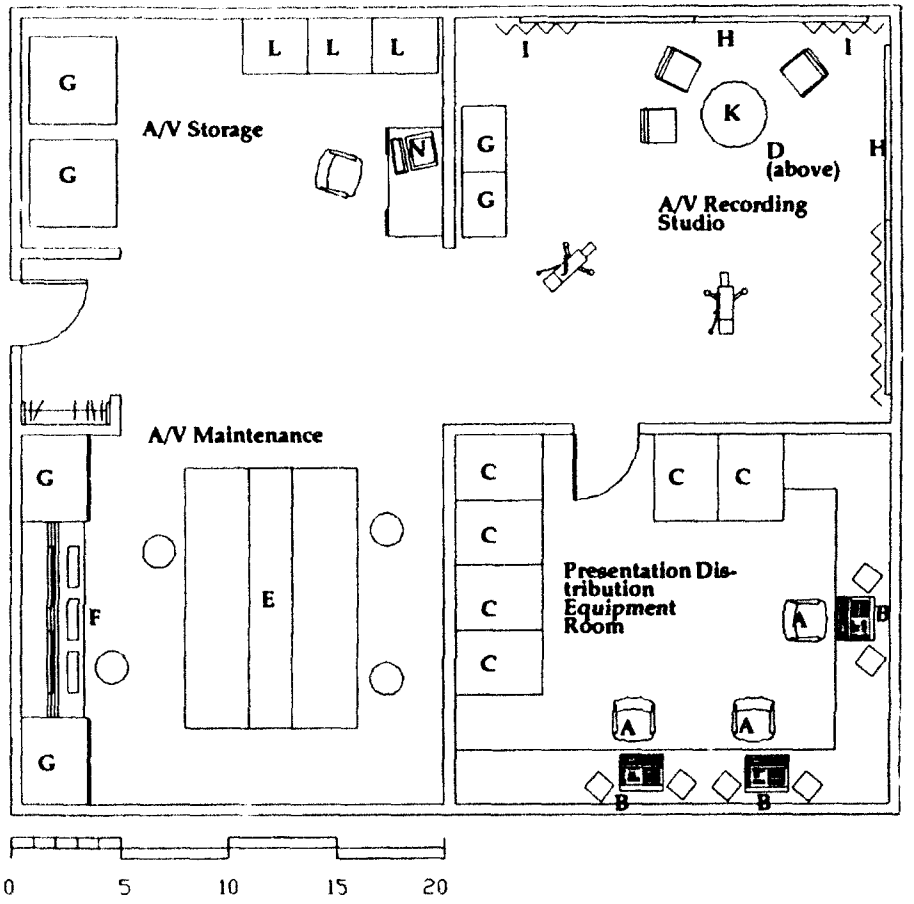
- 1-4 personnel as determined by command center policy and operation

requirements	criteria	commentary
1. Enough space for requisite equipment and personnel with space around equipment for easy servicing.	1. Three separate, but not related, operations need to be accommodated for general use by all command divisions: *Information graphics generation and storage.* Briefing display control. Video recording studio. Required equipment varies with the number of conference rooms served. The space may range from 1000 to 1700 sq. ft. There should be one control console for each conference room.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. Interior finishes suitable for durability, maintenance, and room function.	2. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. Install acoustic tile or fabric-covered panels as required by the acoustic requirements in the recording studio. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	2.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
3. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	3. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise should be between (NC) 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	3.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
4. Comfort features for the occupant such as chair and furniture systems comfort.	4. *Provide each workstation maximum adjustability, such as chairs with* seat height adjustment and workstation components that all have height adjustments.	4.  See Seating section in CCDH Volume 3 (page 7-5).
5. Adequate lighting.	5. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	5.  See Interior Lighting in CCDH Volume 3 (page 7-55).
6. Adequate climate control.	6. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	6.  See HVAC section in CCDH Volume 3 (page 7-65).
7. Accessible power outlets.	7. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall. Provide a raised floor system that allows for easy access to power connections away from the walls.	7. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
8. Fire protection/life safety.	8. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. *Automatic detection/alarm system for Halon underfloor system.*	8.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

guidance/facility component systems

• Acceptable travel distance within the space to the nearest door during a fire:
1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)
2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.

• Acceptable travel distance to the nearest building exit during a fire:
1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)



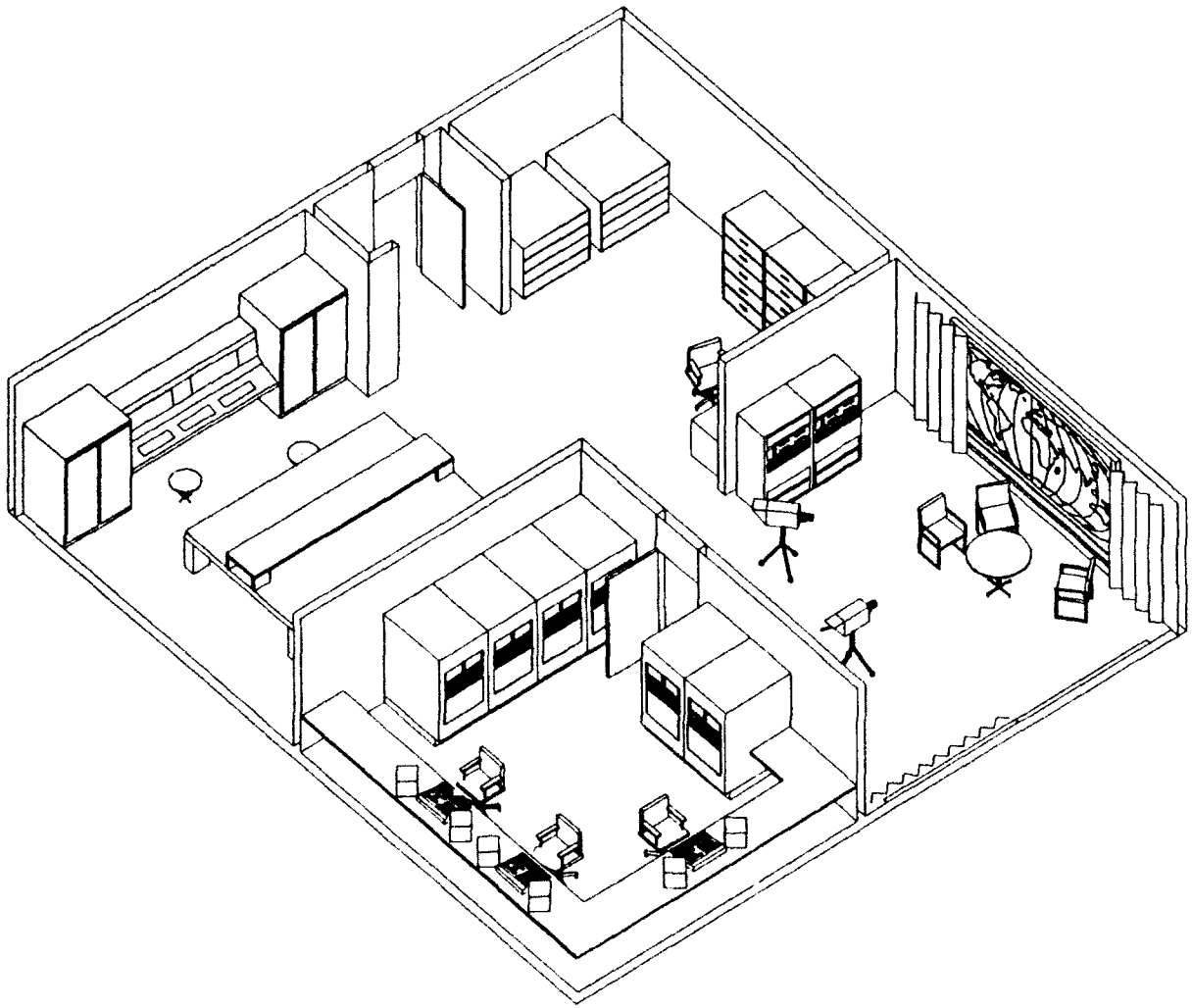
Equipment List

A. Control/console routing switcher (1-3 people)
- Worksurface with storage
- Ergonomic chair(s)
- Control panels
- Video monitors
- Audio monitors

B. Control console for remote presentations
C. Equipment Racks
D. Suspended lighting support
E. Film chain with:
- 8 35mm slide projectors
- 1 70mm slide projector
- 4 vu-graph projectors
- 1 16mm movie camera

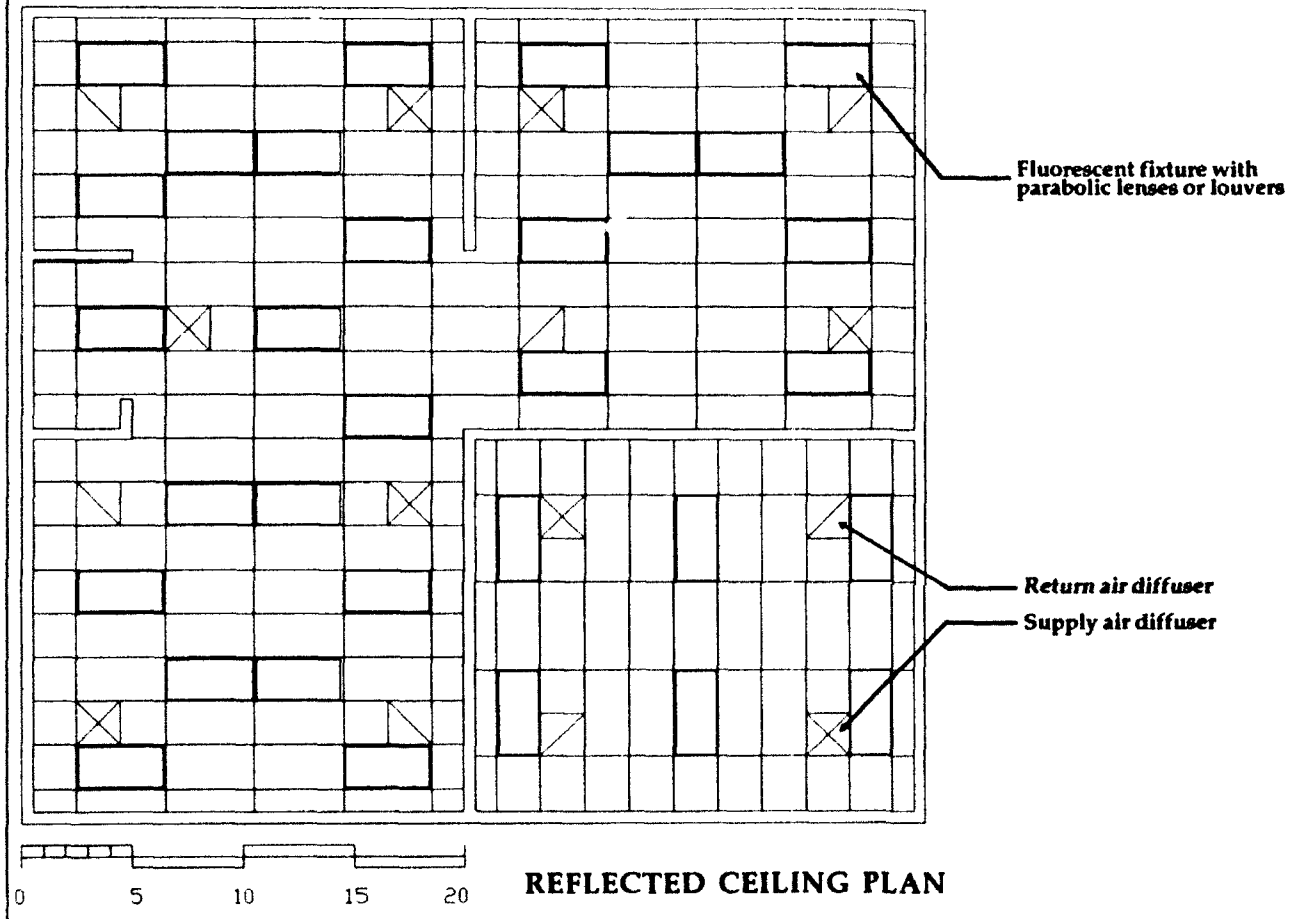
F. Splicing/rewind work table
G. Equipment storage
H. Tack boards
I. Drapes
J. Video cameras
K. Presentation seating
L. Graphic/slide storage
M. Flat drawer storage
N. Graphics inventory and records management computer

guidance/facility component systems



• **Impact of HVAC system noises on acoustical conditions:** Noise from both the air-handling units themselves and the air turbulence at air supply diffusers can seriously impact personnel hearing. All air-handling units should be in enclosed equipment rooms, and it is recommended that the duct velocity be designed at 500 to 700 cu. ft./sec. to minimize diffuser turbulence in rooms where optimum hearing is important.

guidance/facility component systems



REFLECTED CEILING PLAN

• Optimal building mechanical system for equipment protection:

1. An independent air distribution system for electronic equipment spaces is needed.

2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.

3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall be used in electronic equipment cabinets.

4. Duct fire dampers shall be used in ducts that penetrate two-hour fire resistance-rated walls, partitions, shafts.

Policy/SOP

The Graphics Production Area must be maintained in a state of readiness to support immediate or emergency requests for displays or briefing aids to be used in decision briefings. The production of graphics for briefing purposes often involves the use of sensitive and classified material. The Graphic Production Area (or a portion thereof, depending upon the size of the command center and the volume of such information) should be configured to accommodate material up to the SCI level. The production process requires the maintenance of a log of operations which helps in establishing the mean time between failure for automated or computerized graphics production equipment. The production process requires the approval by the officer in charge or the assistant officer in charge of all graphics produced for briefing purposes.

NOTE:
In some command centers, the volume of briefing material to be produced and the complexity of equipment required to produce it may dictate the need to "split" equipment into a conventional area and a computerized area.

S12
GRAPHICS PRODUCTION ROOM

function

For the development and production of graphic display information used by the briefers in support of the command center analysis and decision making procedures. The Graphics Production Area supports both conventional and computerized graphics production.

activities

1. Receive information to be displayed.
2. Develop concept for the display or briefing aid.
3. Select the best method and/or type of graphic for the display or briefing aid.
4. Produce the display or aid.
5. Organize completed displays for delivery.
6. Maintain complete stock of supplies and accessories necessary for production.

equipment

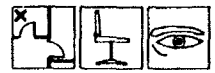
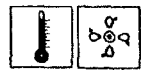
- OIC workstation:
  - Desk
  - Credenza
  - Ergonomic chair
- Graphic technician workstation:
  - Drafting table
  - Overhead storage
  - Layout surface
  - Computer graphics station
  - Ergonomic chair
- WISCUS station
- Plotter
- *Layout surface on flat drawer* files
- Paper cutter
- Light table
- Copier
- Refrigerator
- Freezer
- Copy stand
- Copy camera
- Processor
- Processing sink
- Storage
- Files
- Typesetter
- Ammonia developer
- Schedule display boards

operations

1. Provide an area for the production of briefing aids and graphic displays to enhance the critical information presented during briefings and upon which decisions are based.
2. Provide both conventional and computerized graphics production capability.
3. Provide the capability to produce graphics in a wide variety of types and with a variety of methods in order to enable production personnel to select the method and type which is the best response to a given situation.
4. Provide for the ready access to information needed for the production of graphics.

personnel

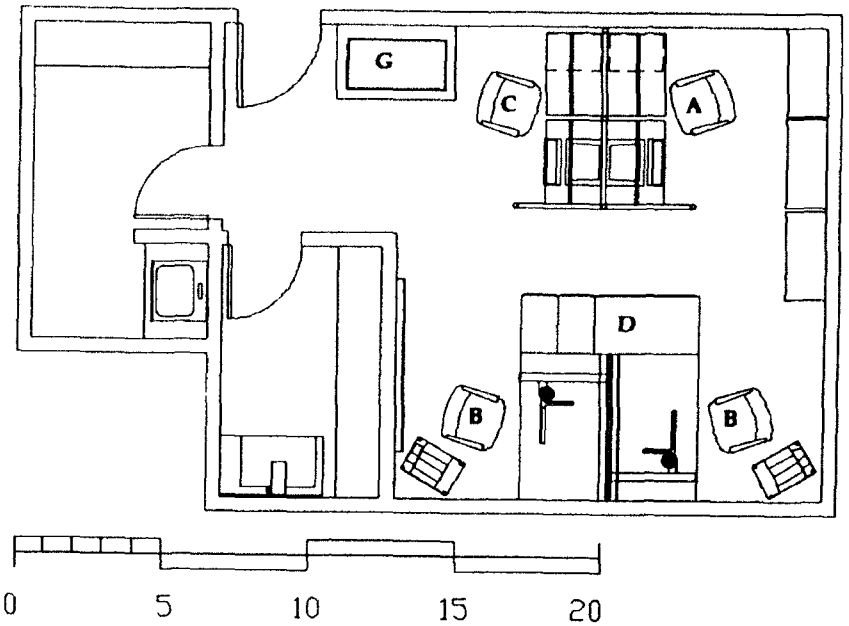
- 1 officer in charge
- 2-4 graphics technicians

requirements	criteria	commentary
1. Enough space to accommodate the equipment and personnel associated with the production of graphics for the briefing and display subsystem.	1. Provide space for the development and production of graphic displays and briefing aids. The space shall take into account the larger workstations required by this activity due to the great amount of layout and drafting surface needed, along with the space necessary for the storage of supplies. Typically, 90 to 100 sq. ft. is required for a graphics technician workstation, with a computer station requiring about 150 to 200 sq. ft. A 2-person operation with a computer would require about 300 to 500 sq. ft. and a 4-person area would require about 600 sq. ft.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. Interior finishes suitable for durability, maintenance, and room function.	2. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	2.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
3. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	3. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise should be between (NC) 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	3.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
4. Comfort features for the occupant such as chair and furniture systems comfort.	4. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	4.  See Seating section in CCDH Volume 3 (page 7-5).
5. Adequate lighting.	5. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	5.  See Interior Lighting in CCDH Volume 3 (page 7-55).
6. Adequate climate control.	6. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	6.  See HVAC section in CCDH Volume 3 (page 7-65).
7. Accessible power outlets.	7. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall.	7. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
8. Fire protection/life safety.	8. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	8.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

guidance/facility component systems

• **Acceptable travel distance within the space to the nearest door during a fire:**
1. Travel distance to the nearest exit access shall not exceed 50 ft. (Without a sprinkler system the travel distance shall not exceed 20 ft.)
2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.

• **Acceptable travel distance to the nearest building exit during a fire:**
1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)



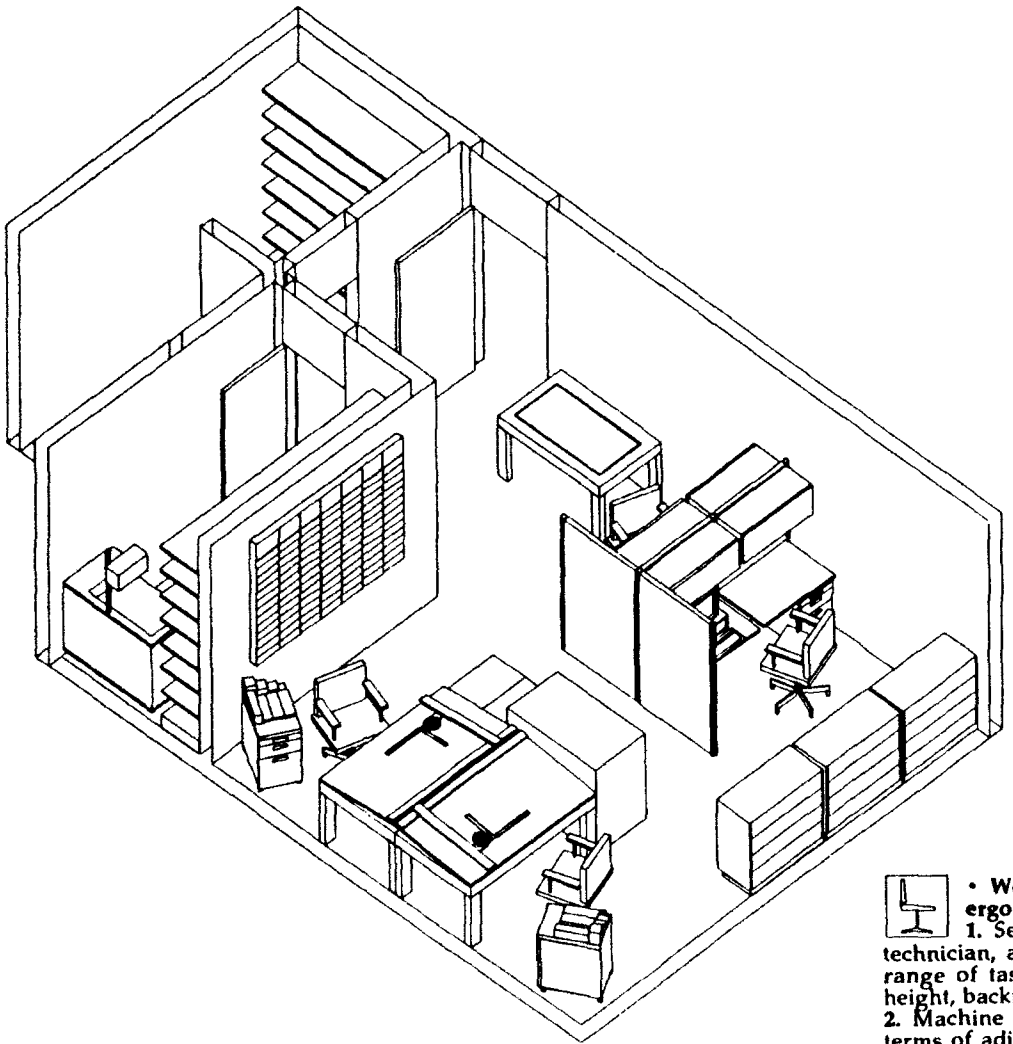
Equipment List

A. OIC workstation:
- Desk
- Credenza
- Ergonomic chair(s)

B. Graphic technician workstation:
- Drafting table
- Overhead storage
- Layout surface
- Computer graphics station
- Ergonomic chair(s)

C. WISCUS station
D. Plotter
G. Light table
H. Copier(s)
I. Refrigerator
J. Freezer
K. Copy stand
L. Copy camera
M. Processor
N. Processing sink
O. Storage
P. Files
Q. Typesetter
R. Ammonia developer
S. Schedule display boards

guidance/facility component systems

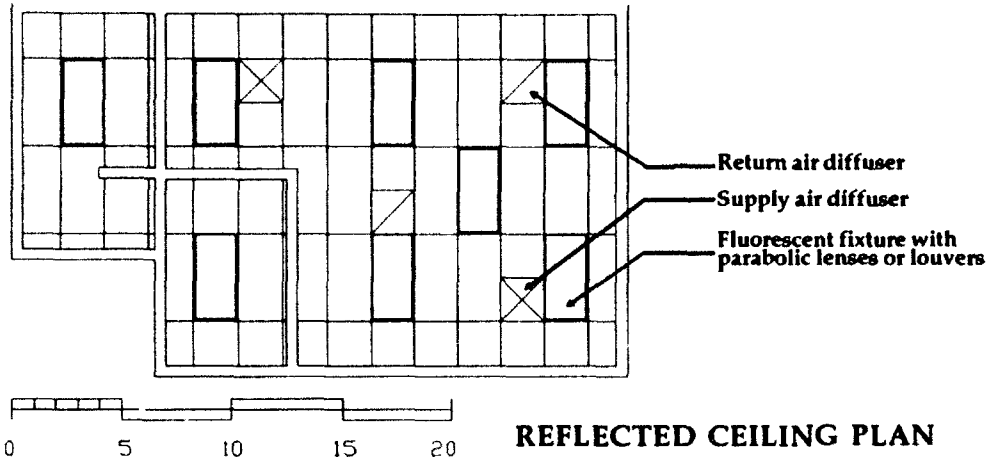


• **Workstation component and seating adjustability for effective ergonomic interaction:**

1. Seating for virtually all positions, clerical, computer operator, technician, and supervisory, should be of the type that is adjustable to a range of tasks and individual needs. Adjustments should include seat height, backrest height, seat pan tilt, and backrest angle.
2. Machine and computer keyboard surfaces are especially important in terms of adjustability -- height, slope, and angle. Video display terminals must be placed at the proper viewing height and angle, along with being adjustable for individual operator needs. Worksurfaces must be located at the proper height for the specified task and be adjustable to suit individual occupant requirements. Suggested surface heights include:

a. working/writing surface: 26"-31".
b. machine interaction surface: 24"-27".
c. computer keyboard surface: 24"-30".

guidance/facility component systems



REFLECTED CEILING PLAN

• **Enable easy ceiling light fixture changes:**
1. It is intended that there will be periodic changes in the location of personnel workstations. The ceiling fluorescent light fixtures must be installed in a manner to allow for any fixture unit to be moved to an adjacent ceiling grid module in any direction.

Policy/SOP

The Commander's Area of the command center shall be allocated according to the policy and regulations governing space on the installation. The Commander's Area will typically comprise the following individual spaces:

Commander's Office
Commander's Secretary Area
Executive Officer's Office
Deputy Commander's Office
Deputy Commander's Executive Officer's Office
Secretary/Receptionist Area
Reception Area
Commander's Lavatory
Conference Area

Depending upon the particular command center, the type and number of spaces may differ in relation to the function and organizational structure present.

Note:
It should be noted that typically during crisis situations, the commander will initially "set up" in the Commander's Conference Area. Also, there have been some instances where crises are entirely run from the Commanders Area.

S13
COMMANDER'S AREA

function

For the accommodation of the commander and director of the command center and for the presentation of the proper "command image" to those both within and outside of the center.

operations

1. Provide direction of the command center.
2. Provide decisions affecting day-to-day operations and during times of crisis situations.
3. Provide policy development and direction for the command center.
4. Provide secretarial/clerical support for the commander's mission.
5. Provide a central point of focus for all command center operations.

notes

SECRETARIAL, CLERICAL, RECEPTION SPACE

activities

1. Receive visitors.
2. Allow visitors to wait.
3. Type.
4. Perform tasks.
5. Route/deliver documentation as needed.
6. Store classified material as needed.

personnel

- 1 receptionist-clerk typist
- 2 secretaries

equipment

- Receptionist station:
  - Worksurface with storage
  - Typing surface
  - VDT surface
  - Printer with stand
  - Terminal
  - Typewriter
  - Ergonomic chair
- Secretary workstation:
  - Worksurface with storage
  - VDT surface
  - Printer with stand
  - Typewriter
  - Terminal
  - Ergonomic chair
  - File cabinet
  - Bookshelves
- Supply storage cabinet(s)
- File cabinet(s)
- Classified material containers
- Visitor seating for 10-15
- Coffee mess with sink and mini-refrigerator
- Telephone/intercom
- Display cabinet/area

COMMANDER AND DEPUTY COMMANDER'S OFFICE

activities

1. Direct and manage the center.
2. Receive/analyze information as it relates to day-to-day operations and/or crisis situations.
3. Issue directives or policy statements concerning command center operation.
4. Hold informal meetings/discussions.
5. Communicate directly with other elements within the command center or with other centers.

personnel

- 1 commander
  0-14 visitors
- 1 deputy commander
  0-10 visitors

equipment

- Commander's office:
  - Worksurface with storage
  - Credenza
  - Terminal stand
  - Printer with stand
  - Conference table with seating for 4-6
  - Visitor seating for 8
  - Bookcase
  - U.S. flag
  - Service flag
- Deputy commander's office:
  - Worksurface with storage
  - Credenza
  - Terminal stand
  - Printer with stand
  - Bookcase
  - Visitor seating for 6
  - Small conference table with seating for 4
  - U.S. flag
  - Service flag
- Lavatory area:
  - Toilet
  - Lavatory
  - Shower
  - Closet - dressing area
- Full communications support:
  - Autovon
  - Red switch
  - Commercial
  - Intercom

EXECUTIVE OFFICER'S OFFICE

activities

1. Assist commander and deputy commander in task completion.
2. Provide information briefings as necessary.
3. Communicate information and command decisions to command center as directed.
4. Screen outside contact as directed by commander.

personnel

- 2 executive officers to support commander
- Deputy commander

equipment

Executive officer's office:
- Worksurface with storage
- VDT surface
- Printer with stand
- Terminal
- File cabinet(s)
- Classified material container
- Bookshelves
- Seating for 4
- Ergonomic chair
- Credenza

Telephone

Intercom

Red switch phone

CONFERENCE ROOM

(See Space C6 for more info.)

activities

1. Monitor current situation.
2. Receive information.
3. Display information.
4. Analyze information.
5. Provide decisions.
6. Communicate decisions.

NOTE: The Commander's Conference Room is similar in function to the CINC Conference Room (Space C-6). The major difference is that this conference room will be used primarily on a day-to-day basis, while the CINC Conference Room is a SCIF and will be operational mainly during a crisis situation.

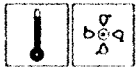
personnel

- 2-10 personnel

1-2 briefers

equipment

- Conference table
- Seating for 10
- Briefing position with information display control panel
- Red/black phones
- Intercom
- Teleconferencing
- Whiteboard/display surface
- World clocks
- Large-screen display system
- Link with appropriate databases

requirements	criteria	commentary
1. Enough space to accommodate personnel, equipment, and furnishings associated with the Commander's Area.	1. Space shall be provided for the monitoring and analysis of force readiness within the command center's AOR. The space for these operations shall be in the range of 400 to 600 sq. ft.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. Interior finishes suitable for durability, maintenance, and room function.	2. *Floors* Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. *Walls* Matte paint over plaster, concrete, or gypsum board. *Ceiling* Exposed spline, suspended acoustical tile. *Base* Vinyl or comparable resilient material.	2.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
3. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	3. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise should be between (NC) 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	3.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
4. Comfort features for the occupant such as chair and furniture systems comfort.	4. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	4.  See Seating section in CCDH Volume 3 (page 7-5).
5. Adequate lighting.	5. Lighting shall be specially engineered. A low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	5.  See Interior Lighting in CCDH Volume 3 (page 7-55).
6. Adequate climate control.	6. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	6.  See HVAC section in CCDH Volume 3 (page 7-65).
7. Accessible power outlets.	7. Provide 120/208 electrical service and 120-volt outlets -- one receptacle for every 10 linear feet of wall.	7. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
8. Fire protection/life safety	8. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system. Automatic wet-pipe or pre-action sprinkler system. Automatic detection/alarm system for Halon underfloor system.	8.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

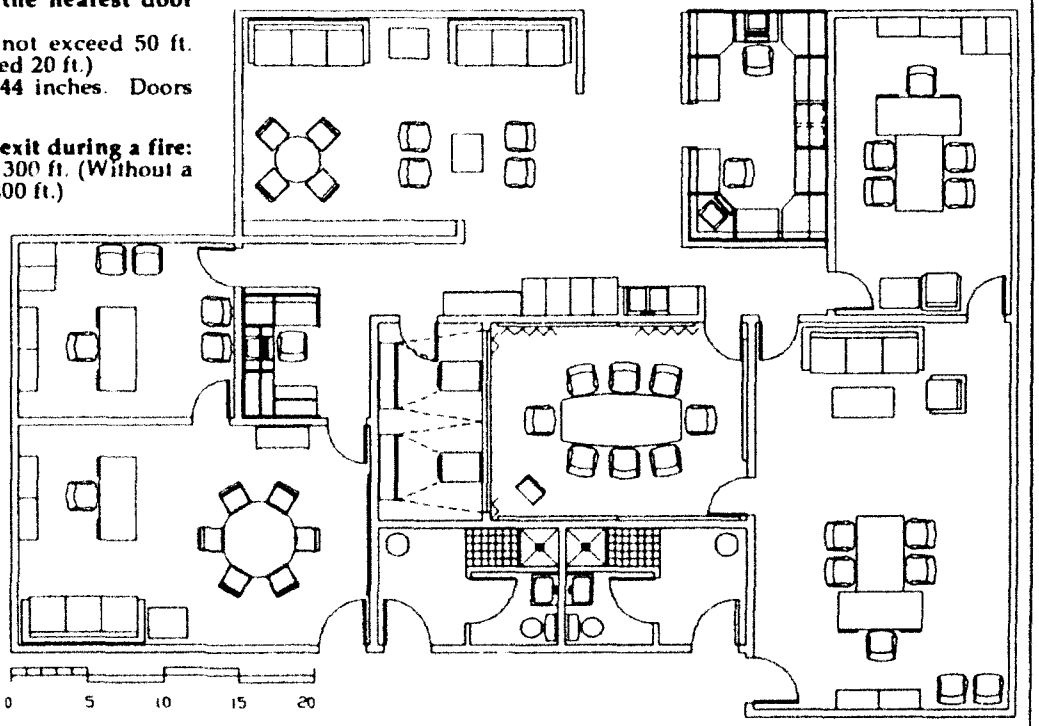
guidance/facility component systems

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2. Minimum width of exit aisles within the space shall be 44 inches. Doors shall swing in the direction of exit.

• Acceptable travel distance to the nearest building exit during a fire:
1. Travel distance to the nearest exit shall not exceed 300 ft. (Without a sprinkler system the travel distance shall not exceed 200 ft.)

• Optimal individual choice for the extent and location of the componentry in personnel workstation modules:
1. Provide personnel workstations using system furniture componentry with a single modular dimension of 36". This allows for:
a. easy rearrangement of all components since they will always be compatible with each other.
b. easy removal of individual desk unit components to accommodate floor-mounted equipment, and then the possible replacement of desk units when the equipment is eventually developed as desktop models. Personnel workstations using system furniture 36" components can be configured as either rectangular or hexagonal modules. The hexagonal modules are recommended for this space.

• Optimal acoustic conditions during high activity periods:
1. In order to provide the best working environment within operations spaces that can accommodate up to 30 or 40 persons at one time, it is suggested that the ceiling surface and available wall surface, where practical, be treated with sound-absorbing material. This treatment will allow for the maximum control of within-room noise levels.



Equipment List

A. Receptionist station:
- Worksurface with storage
- Ergonomic chair(s)
- Typing surface
- VDT surface
- Printer with stand
- Terminal
- Typewriter

B. Secretary workstation:
- Worksurface with storage
- Bookshelve(s)/file cabinet(s)
- Ergonomic chair(s)
- Typing surface
- VDT surface
- Printer with stand
- Typewriter
- Terminal

C. Supply storage cabinets
D. File cabinet(s)
E. Classified material container(s)
F. Visitor's seating for 10-15
G. Coffee mess with sink and mini refrigerator
H. Telephone/intercom
I. Display cabinet/area
J. Commander's office:
- Worksurface with storage
- Conference table with seating for 4-6
- Bookshelve(s)/file cabinet(s)
- Credenza
- Terminal stand
- Printer with stand
- Visitor seating for 3
- U.S. flag
- Service flag

K. Deputy Commander's office:
- Worksurface with storage
- Small conference table with seating for 4
- Bookshelve(s)/file cabinet(s)
- Credenza
- Terminal stand
- Printer with stand
- Visitor seating for 3
- U.S. flag
- Service flag

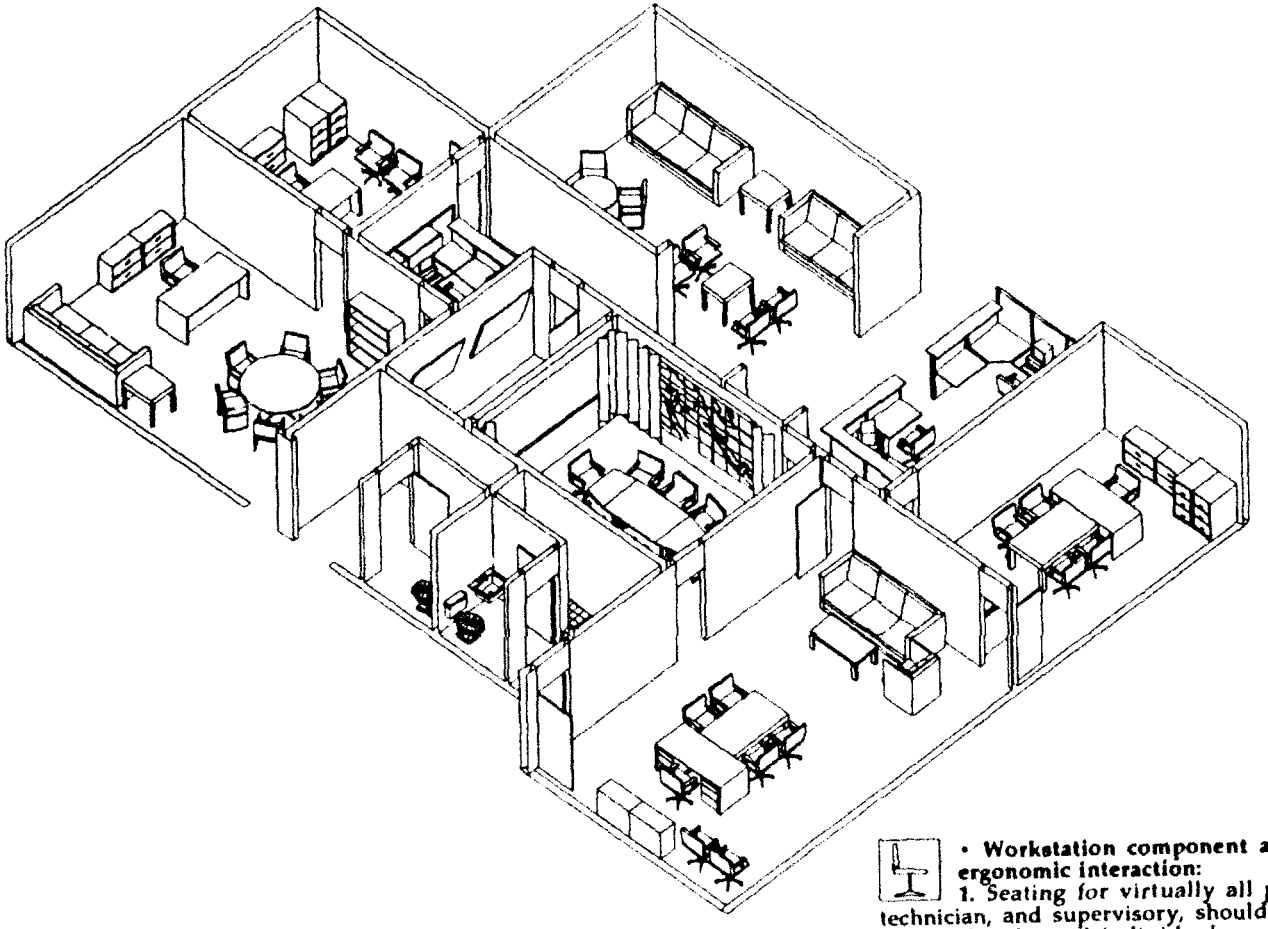
L. Lavatory area (for both offices)
- Toilet
- Lavatory
- Shower
- Closet/dressing area

M. Full communications support:
- Commercial
- Autovon
- Red switch
- Intercom

N. Executive Officer office:
- Worksurface with storage
- VDT surface
- Printer with stand
- Terminal
- Bookshelve(s)/file cabinet(s)
- Classified material container
- Seating for 4
- Ergonomic chair(s)
- Credenza

O. Conference table(s)
P. Briefing Position with information display control panel
Q. Teleconferencing cameras
R. Whiteboard/display surface
S. World clocks
T. Large-screen display system
U. Link with applicable information databases

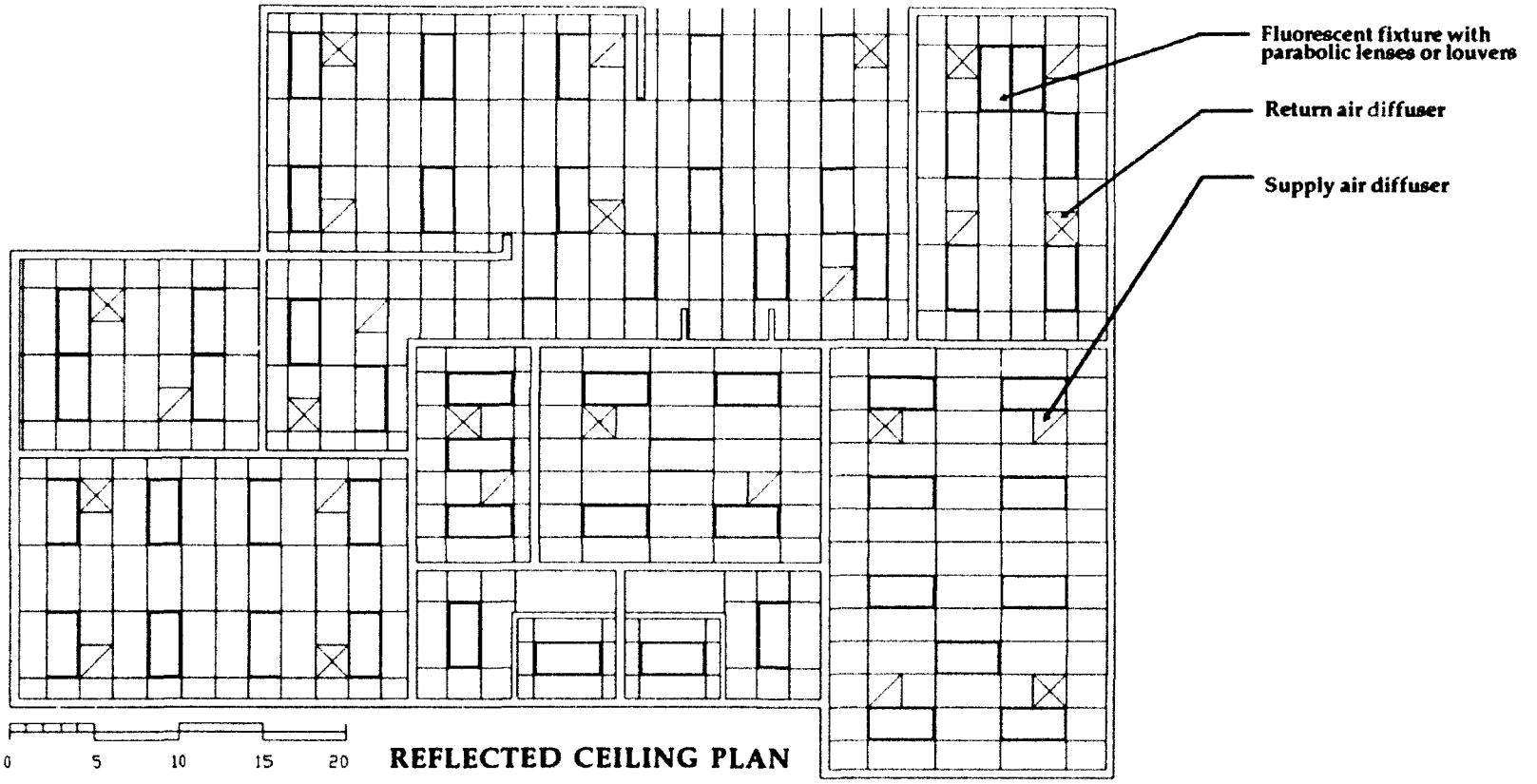
guidance/facility component systems



• **Workstation component and seating adjustability for effective ergonomic interaction:**
1. Seating for virtually all positions, clerical, computer operator, technician, and supervisory, should be of the type that is adjustable to a range of tasks and individual needs. Adjustments should include seat height, backrest height, seat pan tilt, and backrest angle.
2. Machine and computer keyboard surfaces are especially important in terms of adjustability -- height, slope, and angle. Video display terminals must be placed at the proper viewing height and angle, along with being adjustable for individual operator needs. Worksurfaces must be located at the proper height for the specified task and be adjustable to suit individual occupant requirements. Suggested surface heights include:
a. working/writing surface: 26"-31".
b. machine interaction surface: 24"-27".
c. computer keyboard surface: 24"-30".

• **Coordination of graphic presentations by briefers:**
The briefers' lectern should contain the necessary communication connectivity to control the automated presentations and/or the necessary communication connection to those who do manual presentations. Such controls must be simple and obvious, since the briefers must primarily concentrate on text. (Ambient lighting controls should be on the room walls adjacent to the lectern rather than being on the lectern itself.)

guidance/facility component systems



REFLECTED CEILING PLAN

• Optimal building mechanical system for equipment protection:
1. An independent air distribution system for electronic equipment spaces is needed.
2. Pipes/ducts serving other building areas shall be located outside essential electronic equipment spaces.
3. Noncombustible insulation shall be used on pipes/ducts, and noncombustible filters shall be used in electronic equipment cabinets.
4. Duct fire dampers shall be used in ducts that penetrate two-hour fire resistance-rated walls, partitions, shafts.

• Enable easy ceiling light fixture changes:
1. It is intended that there will be periodic changes in the location of personnel workstations. The ceiling fluorescent light fixtures must be installed in a manner to allow for any fixture unit to be moved to an adjacent ceiling grid module in any direction.

• Minimize reflected glare on VDT screens:
1. To reduce glare on video display terminals, use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values. The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On high ceilings, cell depth must be greater, which may dictate a larger cell size.
2. Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

Policy/SOP

The command center spaces must withstand intrusion by individuals intending to compromise the security of the center operation. The concept for providing security at a command center typically consists of five major elements:

Intrusion deterrence
Intrusion detection
Alarm assessment
Component and physical plant hardening
Security or response force personnel

Intrusion deterrence is intended to produce a psychological state of mind in a potential intruder that intrusion will result in unacceptable counteraction. Intrusion detection is intended to provide an alarm to the operating activity or security personnel that an unauthorized intrusion has occurred at a monitored point within the command center. Alarm assessment is intended to verify that an intrusion alarm was activated by a threat against the command center. Component hardening of the physical security system is intended to delay the intrusion to the center long enough for a response to be actuated. Security force is intended to delay, stop or mitigate the actions of an intruder. The security program at each of the command centers shall be based upon these five elements.

Note:

Since most of the command centers are located within established military installations, some elements of the security system for the command center are likely to be part of the installation security system. The concepts are, however, still applicable and should be followed in the context of the command center.

S14
SECURITY OPERATIONS AREA

function

For the protection of the command center operation, the physical security of the command center facility and the accommodation of administrative aspects of the security operation.

operations

1. Provide physical security for the command center operation and personnel.
2. Provide security screening for all personnel entering the command center.
3. Provide security screening to assure that no unauthorized removal of equipment and/or documentation occurs.
4. Provide monitoring of intrusion detection alarm systems and fire/smoke and water detection devices.
5. Provide "roving" security presence within the command center (if applicable).
6. Provide administration of the command center security program.

SECURITY OPS ADMIN

activities

1. Direct and supervise all security elements.
2. Clerical support tasks.
3. Holding of visitors during the security-check process.
4. Storage and distribution of security operations equipment.

personnel

- 1 Security Chief
- 1 Secretary
- 2-4 Guards per station (per shift)

equipment

- Security Chief station:
  - Worksurface with storage
  - File cabinet
  - Ergonomic chair
  - Plan file
  - Table
  - Seating for 4
- Secretarial station:
  - Worksurface with storage
  - Typing/VDT surface
  - Printer stand
  - Ergonomic chair
- Weapons storage area:
  - Storage cabinets
  - Safe
  - Desk and bookshelf area

SECURITY GUARD STATION

activities

1. Screen personnel entering and exiting the command center.
2. Monitor intrusion detection system.
3. Monitor fire/smoke and water security elements.

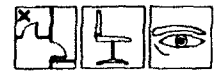
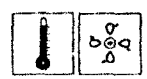
personnel

- 1-2 Guards per station (per shift)

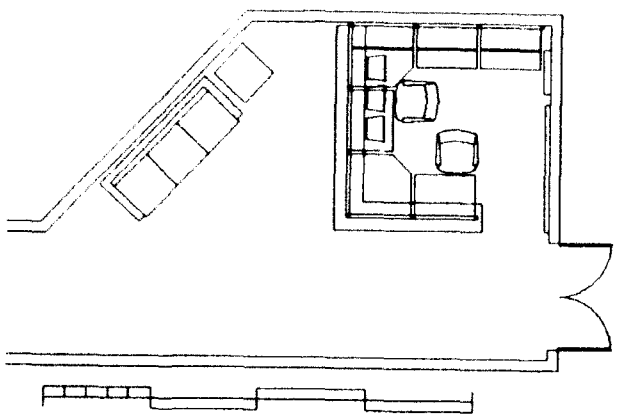
equipment

- Guard station:
  - Worksurface/counter/storage cabinets
  - 2 chair-type stools
- CCTV monitors
- Fire/smoke water alarms
- Intrusion detection system
- Visitor seating for 3
- Badge storage rack
- Secure key storage

rev. Sept '91

requirements	criteria	commentary
1. Visual verification of entering personnel. Enough space to accommodate the personnel and equipment associated with the security operation at guard posts and administrative areas.	1. Provide guard stations at each personnel entry/exit point for badge check and visitor check. The space required for the security operation will vary with the size of the command center, layout of the center, and the number of entrances/exits to be monitored. Area for a typical security administrative area will be in the range of 400 to 500 sq. ft., with each guard station required to monitor points of entrance to the command center needing approximately 100 sq. ft. for the main station and 50 to 75 sq. ft. for auxiliary stations.	1.  See Furnishings section in CCDH Volume 3 (page 7-2).
2. Interior finishes suitable for durability, maintenance, and room function.	2. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. ***Walls*** Matte paint over plaster, concrete block, or gypsum board. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	2.  See Interior Finishes Systems in CCDH Volume 3 (page 7-43).
3. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	3. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise (NC) 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	3.  See Acoustical Quality section in CCDH Volume 3 (page 7-51).
4. Comfort features for the occupant such as chair and furniture systems comfort.	4. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	4.  See Seating section in CCDH Volume 3 (page 7-5).
5. Adequate lighting.	5. Lighting shall be specially engineered. Low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	5.  See Interior Lighting in CCDH Volume 3 (page 7-55).
6. Adequate climate control.	6. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	6.  See HVAC section in CCDH Volume 3 (page 7-65).
7. Accessible power outlets.	7. Provide 120/208 electrical service and 120-volt outlets - one receptacle for every 10 linear feet of wall.	7. See Electrical Power Systems in CCDH Volume 3 (page 7-70).
8. Fire protection/life safety.	8. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system Automatic wet-pipe or pre-action sprinkler system Automatic detection/alarm system for Halon underfloor system	8.  See Fire protection/life safety Systems in CCDH Volume 3 (page 7-79).

guidance/facility component systems

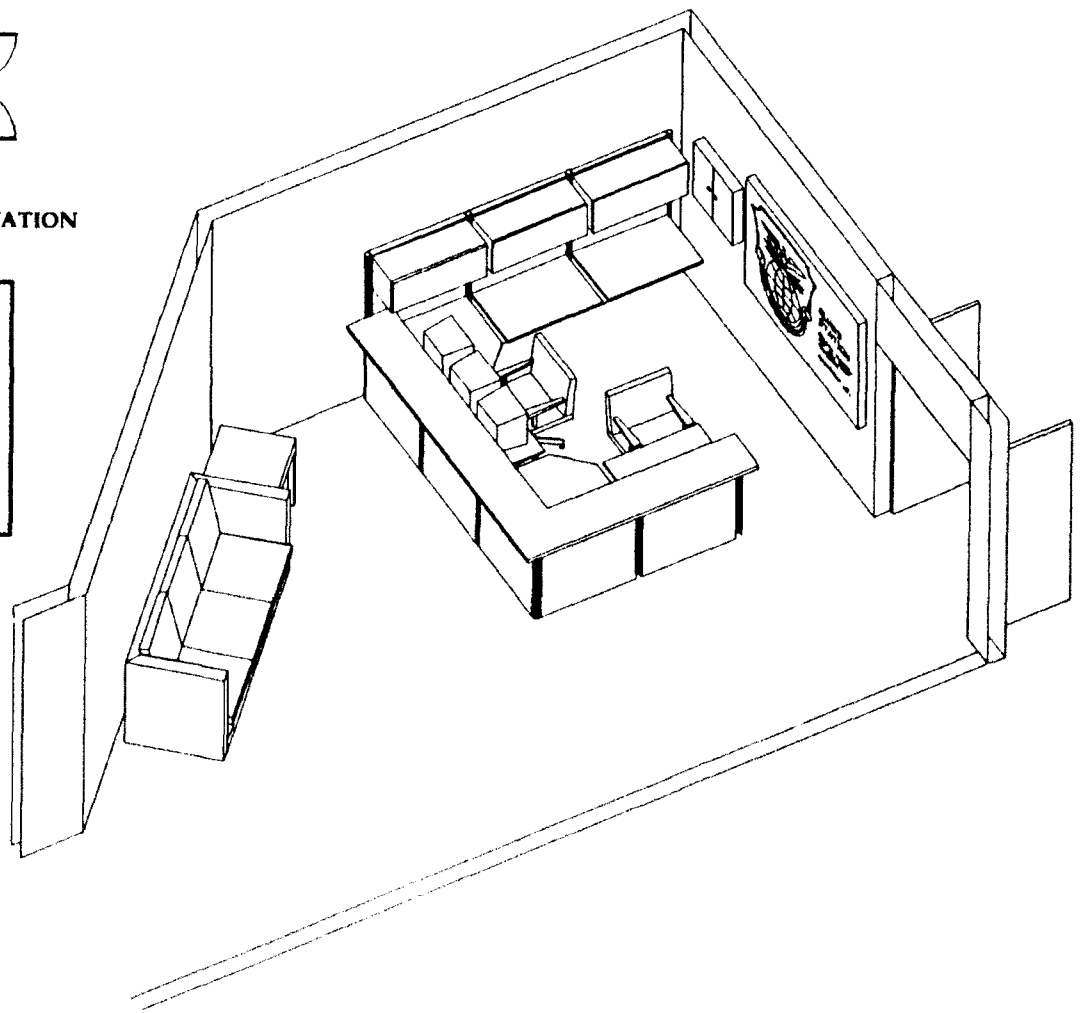


GUARD STATION

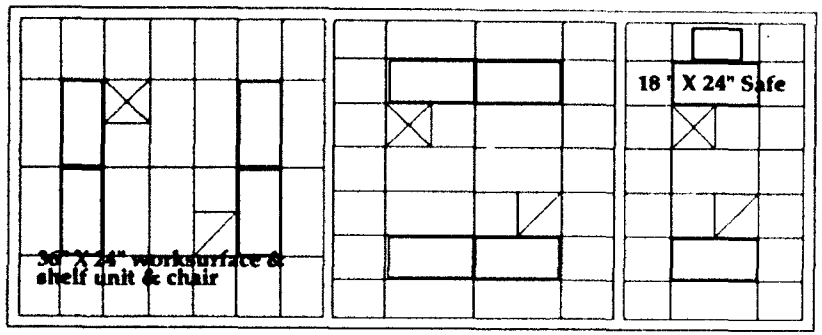
Equipment List: Guard Station

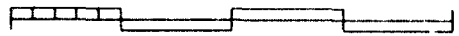
A. Guard Station:
- **Worksurface counter/storage/cabinets**
- **2 Chair-type stools**

B. CCTV Monitors
C. Fire/smoke water alarms
D. Intrusion Detection System
E. Visitor seating for 3
F. Badge storage rack
G. Secure key storage



guidance/facility component systems





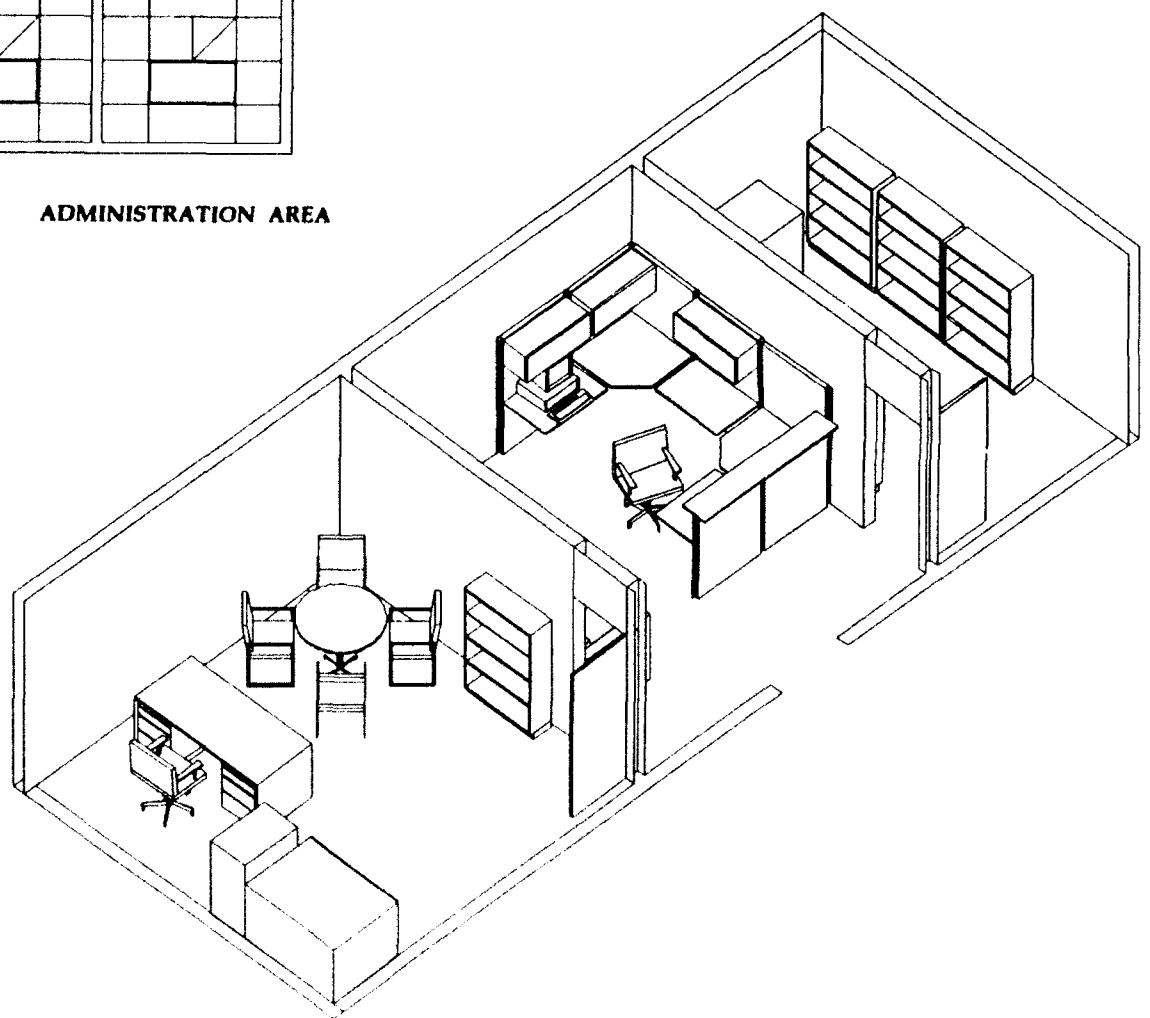
ADMINISTRATION AREA

Equipment List: Administration Area

A. Security Chief station:
- Worksurface with storage
- File cabinet
- Ergonomic chair
- Plan file
- Table
- Seating for 4

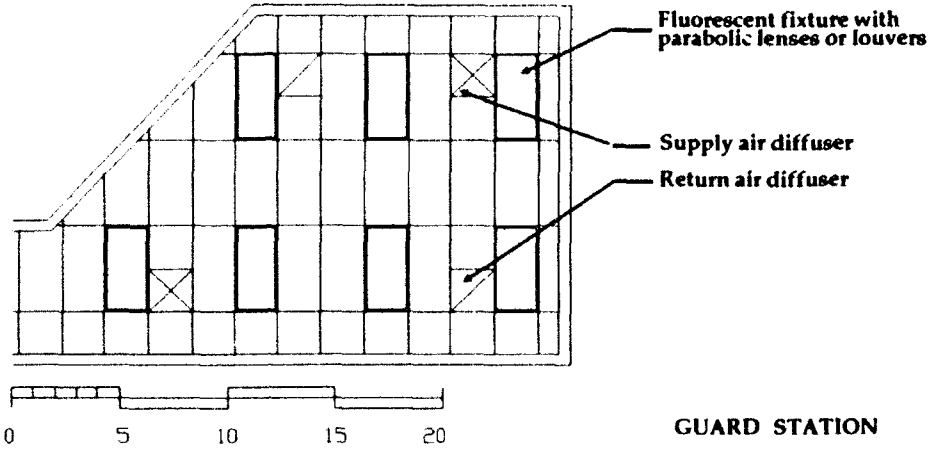
B. Secretarial station:
- Worksurface with storage
- Typing/VDT surface
- Printer stand
- Ergonomic chair

C. Weapons storage area:
- Storage cabinets
- Safe
- Desk and bookshelf area

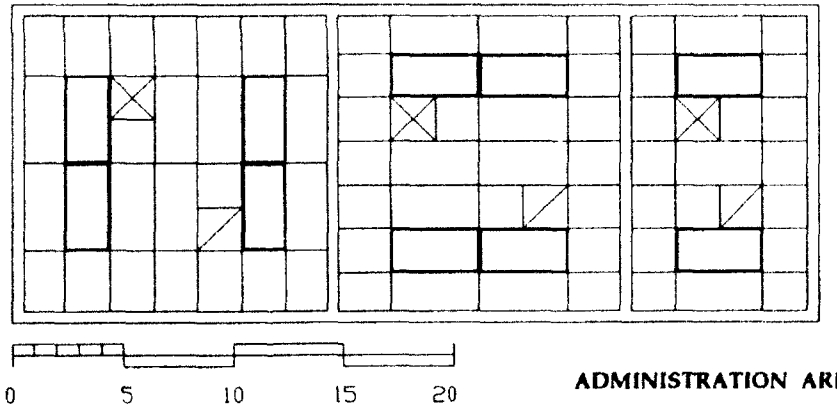


guidance/facility component systems

REFLECTED CEILING PLANS



GUARD STATION



ADMINISTRATION AREA

Policy/SOP

Technical training occurs at two levels: hands-on training, working directly with equipment, and learning from manuals, publications, and audio-visual equipment. Policy requires that personnel be allowed time to train while on duty at the facility. Most hands-on training can be done during periods of limited command center activity or during exercises. This training is done outside the training room.

S15
TRAINING ROOM

function

For the enhancement of the abilities and effectiveness of personnel assigned to the command center, as well as new command center personnel.

activities

1. Studying manuals and other publications.
2. Watching video cassettes, 16mm movies, and slides.
3. Instructing in fire/life/mission safety.
4. Administration of written exams or other test material.
5. Interviews of personnel in groups or individually.

equipment

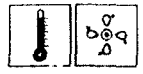
- Table and seating for 10
- Common-use terminal with printer
- Viewgraph projector
- Slide projectors
- Audiovisual projection screen
- Library of written instructional materials
- Whiteboard/display surface
- Tackboard
- Equipment storage cabinet
- Intercom speaker
- Television monitor

operations

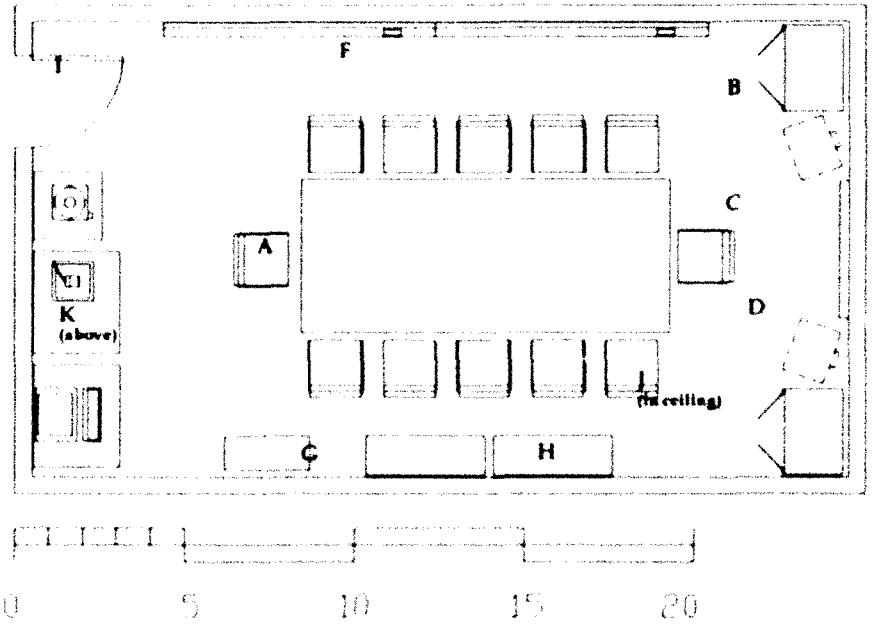
1. Provide an area for the implementation and evaluation of the command center training plan.

personnel

- 2 to 10 command center personnel at one time.

requirements	criteria	commentary
1. Enough space for small groups (up to 12 people) to meet for training seminars. Space for reading and studying manuals and other publications associated with personnel training operations.	1. Provide 25 sq. ft. per person in addition to adequate space for necessary equipment. An example layout of a training room of 300 sq. ft. is shown in the guidance section.	1. 
2. Interior finishes suitable for durability, maintenance, and room function.	2. ***Floors*** Anti-static carpet in roll goods or tiles over non-dusting, hardened concrete. ***Walls*** Paint over gypsum board, or plaster. In some cases, depending upon the acoustical requirements of the training space, acoustical wall treatment such as wall carpeting may be used. ***Ceiling*** Exposed spline, suspended acoustical tile. ***Base*** Vinyl or comparable resilient material.	2.  See Interior Construcion Systems in the CCDH Volume 3 for additional guidance information.
3. Acoustical treatment to provide for a non-disruptive environment and isolate variable noise levels produced by electronic equipment.	3. Provide for a Sound Transmission Coefficient (STC) of 40 or better in open office areas with an STC of 45 or better for private offices. Ambient noise (NC) 35 and NC 40. Reverberation should be 0.8 seconds at 500Hz.	3. 
4. Comfort features for the occupant such as chair and furniture systems comfort.	4. Provide each workstation maximum adjustability, such as chairs with seat height adjustment and workstation components that all have height adjustments.	4. 
5. Adequate lighting.	5. Lighting shall be specially engineered. Low level of lighting contrasts may be required to permit observation of luminous panels without reflected glare. An ambient level of 70 footcandles using fluorescent fixtures is optimal.	5. 
6. Adequate climate control.	6. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate.	6. 
7. Accessible power outlets.	7. Provide 120/208 electrical service and 120-volt outlets - one receptacle for every 10 linear feet of wall.	7. See Electrical Power Systems in the CCDH Volume 3 for additional guidance information.
8. Fire protection/life safety.	8. Fire suppression systems: Automatic Halon 1301, total flooding underfloor system Automatic wet-pipe or pre-action sprinkler system Automatic detection/alarm system for Halon underfloor system	8. 

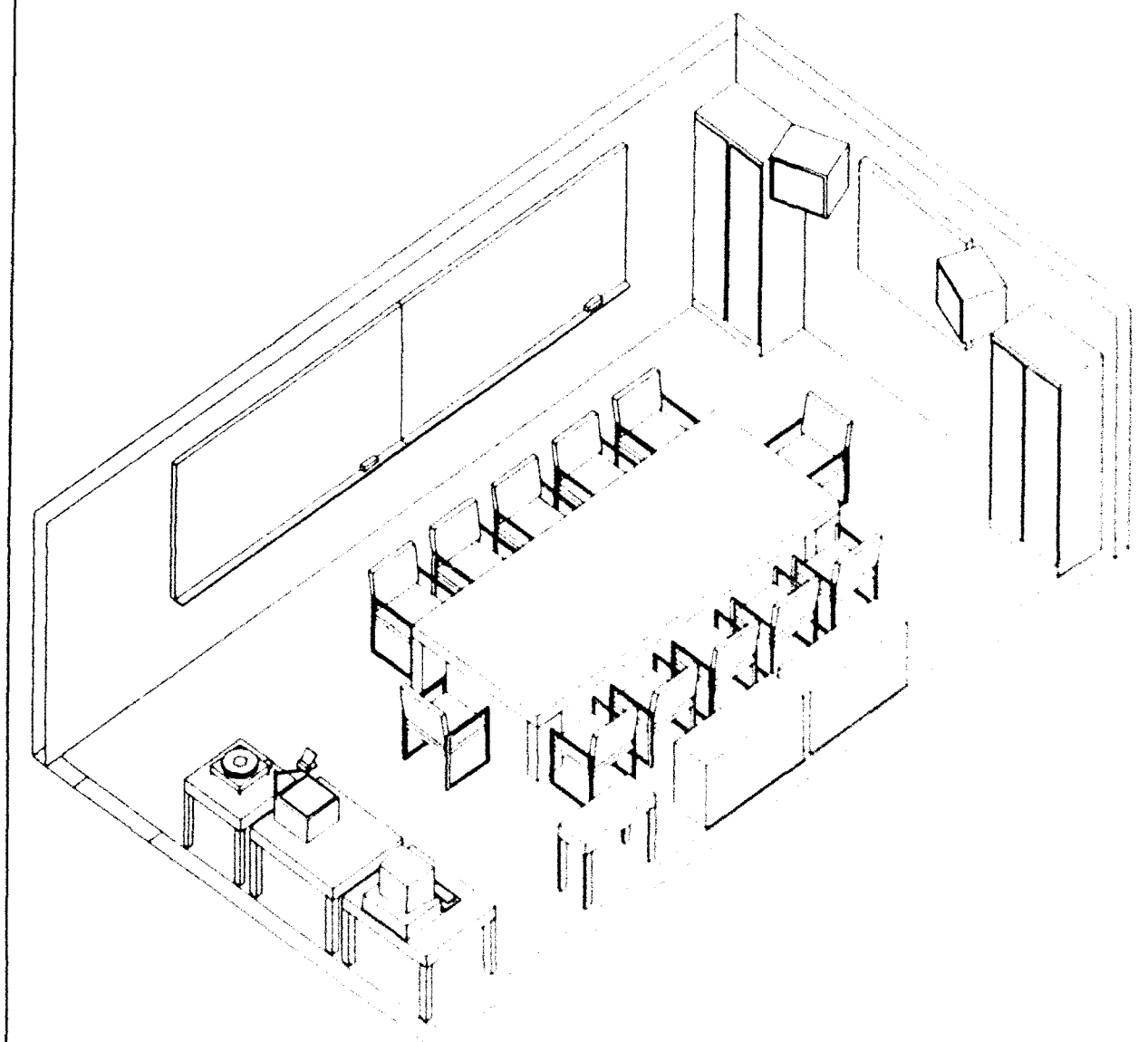
guidance/facility component systems



Equipment

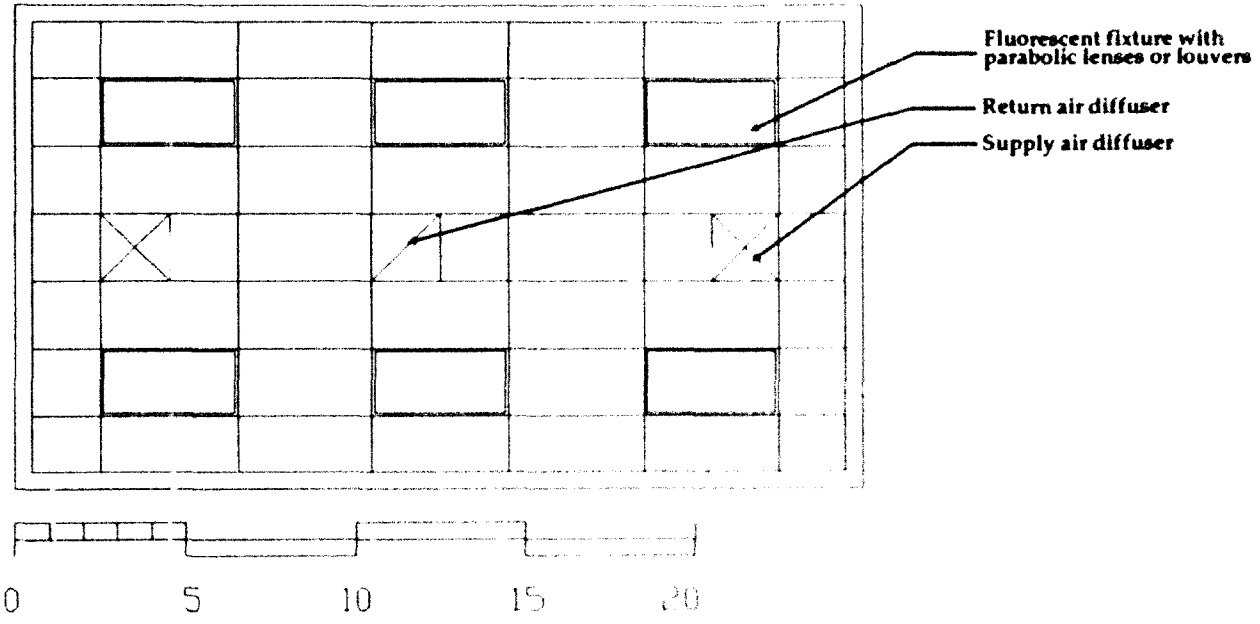
A. Table and seating for 10
B. Common-use terminal with printer
C. Viewgraph projector
D. Slide projectors
E. Audiovisual projection screen
F. Library of written instructional materials
G. Whiteboard/display surface
H. Tackboard
I. Equipment storage cabinet
J. Intercom speaker
K. Television monitor

guidance/facility component systems



guidance/facility component systems

REFLECTED CEILING PLAN



Policy/SOP

The intense activities within the command center during an exercise or crisis situation generate personnel fatigue, making it necessary to separate personnel from the monitoring, communications, planning, and decision-making functions. Typically, policy within the services require personnel to have a 15-minute break every 3-4 hours. Schedules also allow 30-minute meal breaks. Since a great number of command center personnel "brown bag" their meals, a basic food preparation capability is required: sink, hotplate, refrigerator, cabinets, and range.

S16
PERSONNEL SUPPORT ROOM

function

For the temporary change of environment and/or to provide a relaxing break area away from the core areas for the command center personnel assigned for extended periods of time during contingency exercises and crisis situations.

activities

1. Relaxing
2. Reading
3. Eating
4. Storing food
5. Preparing food
6. Personal communication
7. Storage of personal items such as coats and books
8. Smoking

equipment

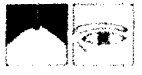
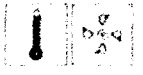
- Refrigerator
- Range and range hood
- Small sink
- Countertop for food preparation with cabinets below and above
- Coffee machine
- Easy chairs
- Table with chairs for 8
- Bulletin boards
- Intercom speaker
- Storage lockers for those personnel not having offices or areas to secure personal items
- Coat rack
- Microwave oven (only if other equipment within the center will not be affected)
- Trash receptacles
- Telephone
- Air ionizer/purifier

operations

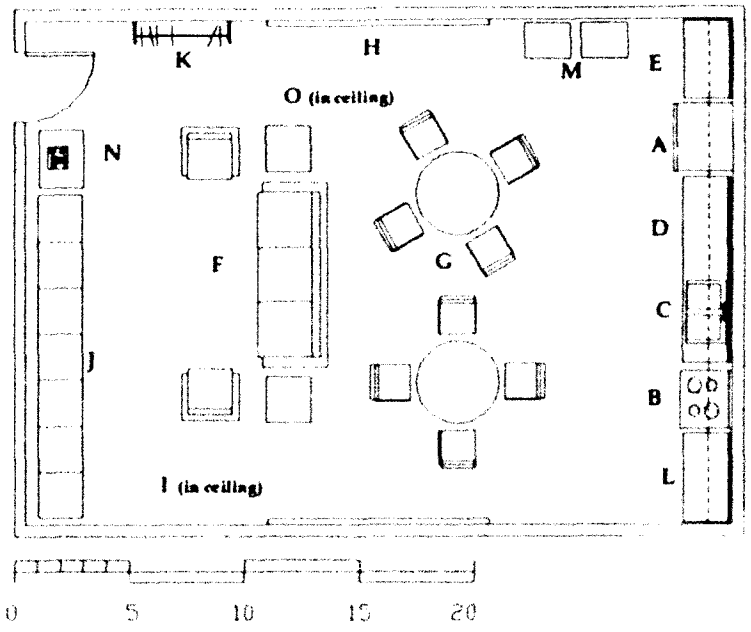
1. Provide the command center personnel an area to relax away from the activity and pressure of the command center core.
2. Provide an area for the command center personnel to store and prepare simple meals and beverages.
3. Provide prepared food and beverage vending machines for the command center personnel.
4. Provide an area for personal communication and socialization.

personnel

- 2-15 center personnel at one time

requirements	criteria	commentary
1. Enough space to accommodate equipment and furniture associated with the personnel support and break area.	1. Provide approximately 400 sq. ft. of space for equipment and furniture to accommodate 10 to 12 personnel at one time.	1. 
2. Visual separation from the command center core spaces.	2. It is important to the function of the room to physically separate the area from other, high-tension, command center activities. The visual separation may also be achieved by completely changing the decor of the space from the high-tech, equipment-oriented spaces of the core to a subdued, "soft", inviting area.	2.  See Interior Construction Systems in the CCDH Volume 3 for additional guidance information.
3. Interior finishes suitable for durability, maintenance, and room function.	3. ***Floors*** Vinyl asbestos tile or quarry tile in the food preparation and eating areas. Carpet or carpet tiles in the sitting and relaxing area. ***Walls*** Paint, vinyl wall covering, or wall carpeting over gypsum board or plaster. ***Ceiling*** Acoustic tile. ***Base*** Rubber, vinyl, or comparable resilient base material.	3. 
4. Acoustical isolation and attenuation for a non-disruptive environment.	4. The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum) and floor material should be rated at NRC .25 (minimum).	4. 
5. Comfort features for the occupant such as chair and furniture systems comfort.	5. Provide comfortable furniture for break time relaxing. Earth tones/colors are recommended for wall paint, carpeting, and furniture.	5. 
6. Lighting suitable for the various personal activities taking place within the space.	6. The lighting system designed for the personnel support area should, in order to reinforce the intent of the room, be something completely different than the remainder of the command center. Low levels of incandescent illumination are recommended with greater illumination directed over the food preparation area. The system should be controllable by personnel to achieve various levels throughout the space to satisfy differing user needs.	6. 
7. Adequate climate control.	7. Control temperature for 68°F (heating) and 72°F (cooling) with a 5 cubic foot per minute per person outside air ventilation rate	7 
8. Accessible power outlets.	8. Provide 120/208 electrical service and 120-volt outlets - one receptacle for every 10 linear feet of wall.	8 See Electrical Power Systems in the CCDH Volume 3 for additional guidance information
9. Fire protection/life safety.	9. Fire suppression systems Automatic Halon 1301, total flooding underfloor system Automatic wet-pipe or pre-action sprinkler system Automatic detection/alarm system for Halon underfloor system	9 

guidance/facility component systems

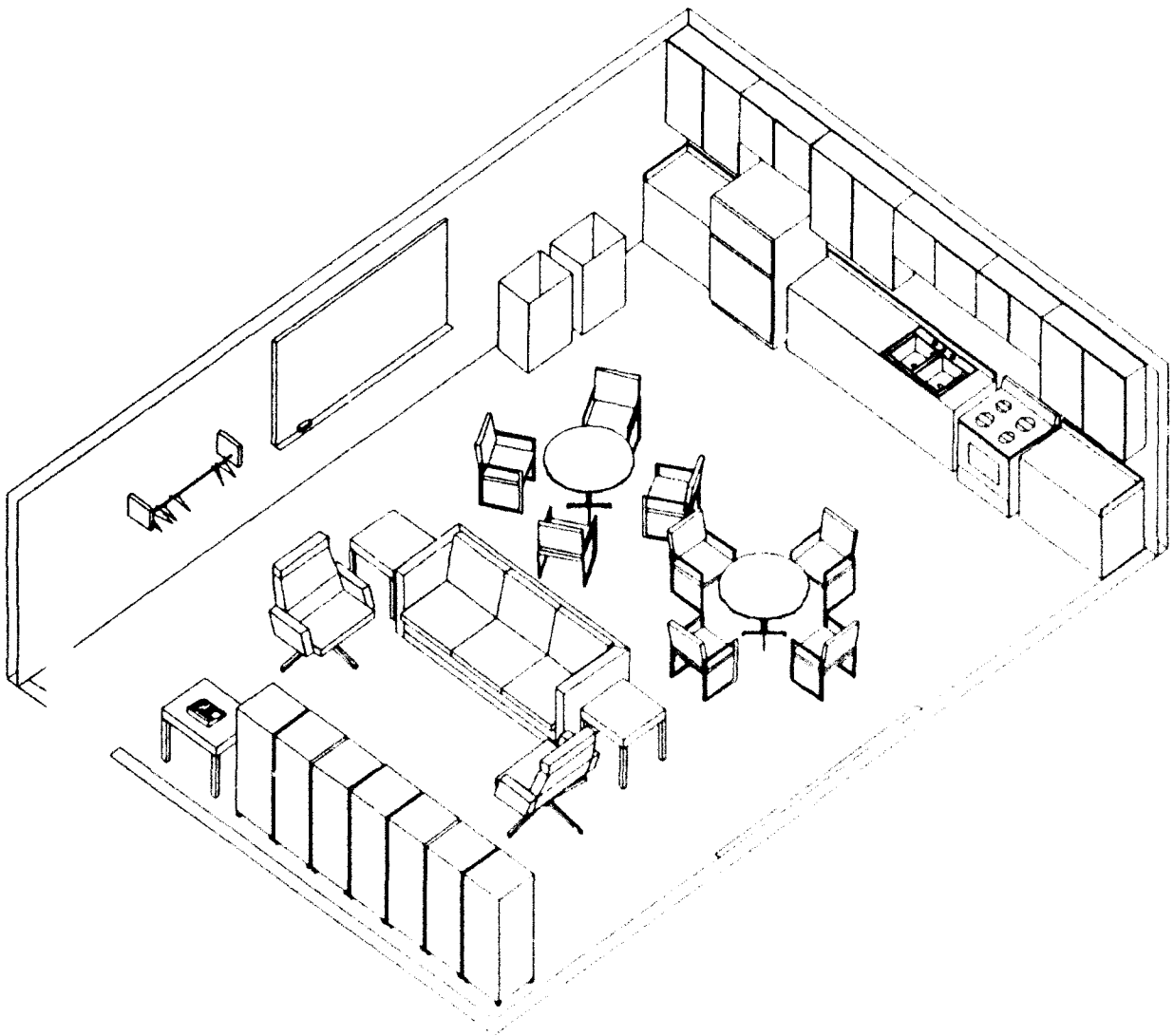


Equipment

A. Refrigerator
B. Range and range hood
C. Small sink
D. Countertop for food preparation with cabinets below and above
E. Coffee machine
F. Easy chairs
G. Tables with chairs for 8
H. Bulletin boards
I. Intercom speaker
J. Storage lockers for those personnel not having offices or areas to secure personal items
K. Coat rack
L. Microwave oven (only if other equipment within the center will not be affected)
M. Trash receptacles
N. Telephone
O. Air ionizer/purifier

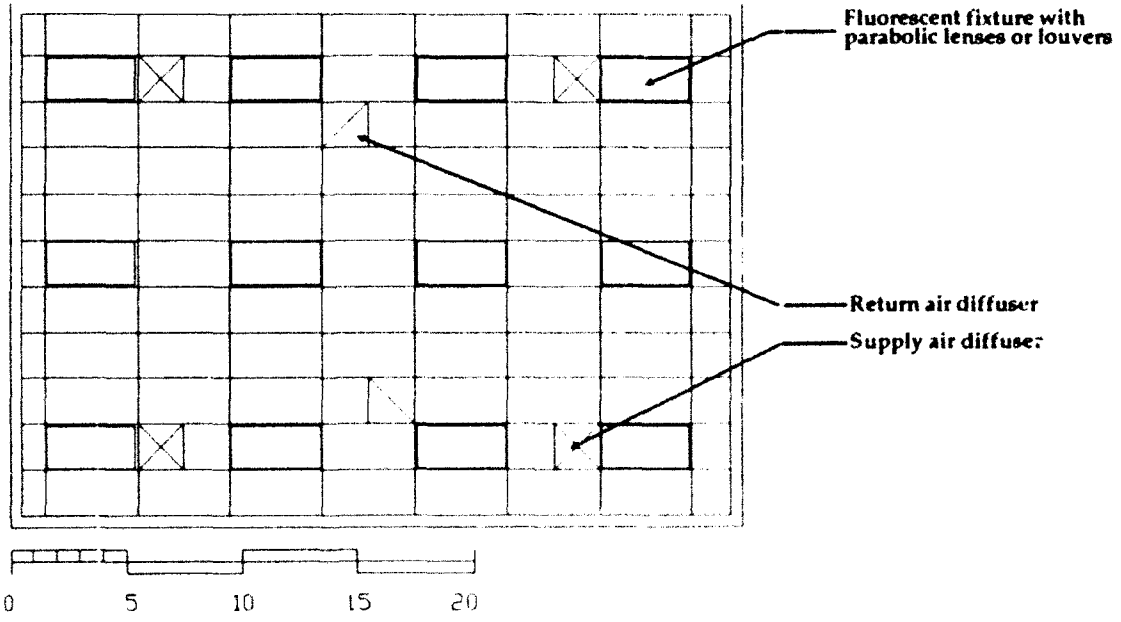
Personnel Support Room S16-5

guidance/facility component systems



guidance/facility component systems

REFLECTED CEILING PLAN



Policy/SOP

At a minimum, the design of fire protection and life safety systems shall include:

a. Identifying risks and hazards.
b. Establishing procedures for the reporting and abatement of risks and hazards.
c. Reviewing procedures for new construction plans and proposals for structural and occupancy modifications of existing facilities.
d. Testing, inspecting, and maintaining:
    1) Water supply systems
    2) Fire hydrants
    3) Manual notification and alarm systems
    4) Automatic detection and alarm systems
    5) Automatic fire suppression systems
    6) Standpipe systems
    7) Portable fire extinguishers

The responsibility for providing interpretation or clarification of criteria contained in regulations is assigned to the following military departments who are the "authority having jurisdiction" in referenced codes and standards

Air Force:	HQ SAF/LEEE
Army:	HQ USACE/DAEN-EXE-D
Navy:	HQ NAVAFACENGCOM/CODE O4F

Deviations or waivers from established criteria require prior approval by the military department

S17
CIRCULATION SPACES

function

For effective and efficient occupant circulation between all rooms and spaces within the command center and to produce an acceptable level of risk in systems for fire protection and life safety without compromising the command center mission. Fire protection and life safety systems must provide the command center with the capability to reduce the risks of loss of life due to fire, smoke, toxic fumes, panic, hostility threats, and other hazards and emergencies.

operations

1. Provide sufficient and adequate exits without dependence on any single safeguard.
2. Provide construction which maintains structural integrity during an emergency while occupants are exiting.
3. Provide the type, number, location, and capacity of exits, based on the occupancy type, number of occupants, and available fire protection (see fire protection and life safety systems, Vol. 3).
4. Provide exits that are clear, unobstructed, and unlocked.
5. Provide exit identification and exit illumination to insure that routes of escape are clearly marked and visible so there is no confusion or danger of panic in reaching an exit in an emergency.
6. Provide protection features that buy time in the event of an emergency for proper exiting (i.e., detection, alarm, sprinklers, smoke partitions, etc. See fire protection systems, Vol. 3).
7. Provide fire alarm systems to insure early warning of an emergency where facility size or arrangement is such that the emergency itself would not provide sufficient advance warning to allow safe exit.
8. Provide for redundant (backup) safeguards to permit alternative escape in the event of an emergency.
9. Provide protection of vertical and horizontal openings until safe exiting can be accomplished.

activities

1. Means of egress and evacuation routes for all occupants of the command center in case of emergency.
2. Access to all rooms and functional spaces by emergency action teams, security forces, and/or off-site emergency response forces.
3. Occupant circulation between all rooms and functional spaces within the command center.
4. Social interaction nodes at appropriate locations (i.e., bulletin boards and displays).

equipment

- Emergency lighting battery packs
- Lighted exit signs
- Fire detection devices (i.e., smoke, heat, flame detectors)
- Alarm horns, bells, lighted devices
- Smoke removal equipment (i.e., stair pressurization equipment)
- Labeled fire doors
- Portable fire extinguishers/ cabinets
- Bulletin boards/display cases
- Manual fire alarm pull boxes
- Fire standpipes (in exit stairs greater than 3 stories)
- Automatic sprinkler system (in windowless and underground facilities)

requirements	criteria	commentary
1. Exit capacity sufficient for the total occupant load of the command center.	1. Each occupant shall have access to at least two exits, remotely located, and arranged such that in the event of a fire or other emergency, travel to an exit will not exceed the required exit travel distances. Exit travel via designated required exit stairways shall be arranged so that a fire located on one floor will not preclude the use of that stairway by building occupants.	1. 
2. Interior finishes suitable for durability, maintenance and the vertical and horizontal emergency circulation.	2. Facilities shall be constructed and maintained such that a fire on one level or in one fire area on the same level will not propagate vertically or horizontally via unprotected floors, stairways, shaft openings, or wall openings, and thereby threaten employees on other levels or in adjacent spaces. Structural components and assemblies shall be noncombustible and no interior finish shall be employed which will significantly increase the fire and life safety hazard to employees with respect to flame spread, smoke development, or fuel contribution.	2. 
3. Exitway illumination and emergency lighting.	3. Major paths of exit travel, including corridors and stairways, shall be provided with appropriate exit signs and both normal and emergency illumination.	3. 
4. Fire alarm and detection equipment/system.	4. In parts of the command center that are arranged such that a fire-related mishap will not be readily apparent to building occupants by virtue of significant interior partitioning, multiple floor levels, or high ambient noise levels, thus posing a threat of possible entrapment, a fire alarm featuring bells, horns, red rotating beacons, or flashing lights, shall be operative from a corridor pull-box.	4. 
5. Manual and automatic fire extinguishing equipment.	5. Portable fire extinguishers shall be provided for the building horizontal and vertical circulation exitways for personnel use. An automatic wet-pipe or per-action sprinkler system is also required.	5. 

LIST OF ACRONYMS

	-A-
ADP	Automated Data Processing
AEPDS	Automated Emergency Action Message Processing and Dissemination System
AFSATCOM	Air Force Satellite Communications
AHU	Air Handling Unit
AIM	AFSATCOM IEMATS Microprocessor
ALCOP	Alternate Command Post
AMES	Automated Message Entry System
AMH	Automated Message Handling
AMHS	Automated Message Handling System
AMPE	Automatic Message ProcessingEquipment
AMPS	Automatic Message Processing System
AO	Action Officer
AOBC	Action Officer Briefing Console
AOR	Area of Responsibility
APES	Activity Personnel Equipment Schedule
ARPCA	Automatic Remotely Programmable Conference Arranger
AUTODIN	Automated Digital Network
AUTOSEVOCOM	Automatic Secure Voice Communications
AWAS	Airborne Warning and Control System
AWDS	Automatic Weather Distribution System
AWN	Air Weather Network
ANWS	Alpha-Numeric Wall Display
	-B-
BDS	Briefing and Display Subsystem
BSSC	Battle Staff Support Center
	-C-
C2	Command and Control
C3	Command Control and Communications
C31	Command Control Communications and Intelligence
CAC	Current Actions Center
CAMHS	Compact Automated Message Handling System
CAS	Crisis Action System
CAT	Crisis Action Team
CC	Command Center
CCDH	Command Center Design Handbook
CCIP	Command Center Initiatives Program
CCIS	Command Center Information System
CCIU	Command and Control Information Utility
CCPDS	Command Center Processing and Display System
CCTV	Closed Circuit Television
CFM	Cubic Feet Per Minute
CINC	Commander in Chief
CM	Crisis Management
CMIS	Crisis Management Intercom System
CMS	Configuration Management System
COA	Course of Action
COMSEC	Communication Security
COPREC	Command Post Record Capability
COTS	Commercial/Off the Shelf
CUS	Common User System
CWO	Communications Watch Officer
	-D-
DAT	Deployment Action Team
DBS	Direct Broadcast System
DCA	Defense Communications Agency
DIA	Defense Intelligence Agency
DISA	Defense Information System Agency
DDN	Digital Data Network
DEFCON	Defense Condition
DID	Display Interface Device
DISIDS	Display and Information Distribution System
DMS	Defense Message System
DOT	Deployment Operation Team
DSCS	Defense Satellite Communication System
	-E-
EA	Emergency Actions
EAM	Emergency Action Message
EMP	Electromagnetic Pulse
EW	Electronic Warfare
	-F-
FAX	Facsimile
FC	Foot Candle
	-G-
G/AIT	Ground/Airborne Integrated Terminal
GOES	Geostationary Optical Environmental Satellite
GOSIP	U.S. Government Open Systems Interconnection Profile
GWEN	Ground Wave Emergency Network
	-H-
HEMP	High Altitude Electromagnetic Pulse
HF	High Frequency
HVAC	Heating, Ventilation, Air Conditioning

-I-

ICN	Interconnected CCPDS Network
IEMATS	Improved Emergency Message Automatic Transmission System
IPS	Information Processing Subsystem
IW	Indications and Warning
IWT	Intelligence Watch Team

-J-

JCS	Joint Chiefs of Staff
JCSAN	JCS Alerting Network
JINTACCS	Joint Interoperability of Tactical Command and Control Systems
JOC	Joint Operations Center
JOPES	Joint Operations Planning and Execution System
JPS	JOPES Planning System
JRC	Joint Reconnaissance Center
JSE	JOPES Support Element
JTF	Joint Tack Force
JTIDS	Joint Tactical Information Distribution System
JTC3A	Joint Tactical Command, Control and Communications Agency
JVIDS	Joint Visually Integrated Display System

-L-

LAN	Local Area Network
LCCN	Local Command Center Network
LF	Low Frequency
LPTV	Low Power Television
LS	Large Screen
LSD	Large Screen Display
LSDS	Large Screen Display System
LSWD	Large Screen Wall Display

-M-

MILCON	Military Construction
MIS	Management Information System
MLS	Multilevel Security
MWDS	Missile Warning Display System
MWS	Missile Warning System
MWTTY	Missile Warning Teletype

-N-

NC	Noise Criteria
NCA	National Command Authority
NCO	Non-Commissioned Officer
NCOIC	Non-Commissioned Officer in Charge
NEACP	National Emergency Airborne Command Post
NEDS	Naval Environmental Data System
NIDS	NMCS Information and Display System
NMCS	National Military Command System
NORAD	North American Aerospace Defense Command
NPDS	NMCS Processing and Display System
NPES	Nuclear Planning and Execution System
NRC	Noise Reduction Coefficient

-O-

OCR	Optical Character Recognition
OPG	Operations Planning Group
OPINT	Operations Intelligence
OPLANS	Operations Plans
OPORDS	Operations Orders
OSC	Operations Support Center

-P-

PBX	Private Branch Exchange
PC	Personal Computer
PIN	Personnel Identification Number
POC	Point-of Contact
POE	Post Occupancy Evaluation
POL	Petroleum, Oil, Lubricants

-R-

RAM	Random Access Memory
RECA	Residual Capability Assessment
RJE	Remote Job Entry
RLP	Remote Laser Printer
ROC	Required Operational Capability
ROE	Rules of Engagement

-S-

SATCOM	SatelLite Communications
SCI	Sensitive Compartmented Information
SCIF	Sensitive Compartmented Information Facility
SF	Square Feet
SIOP	Single Integrated Operations Plan
SON	Statement of Operational Need
SOTA	State of the Art
STC	Sound Transmission Coefficient
STU	Secure Telephone Unit

-T-

TA/CE	Technical Assessment Cost Estimate
TEMPEST	Communications Security
TUDE	Terminal User Data Entry

TW/AA	Tactical Warning/ Attack Assessment

-U-

UHF	Ultra High Frequency
UPS	Uninterruptable Power Supply

-V-

VCP	Visual Comfort Probability
VDT	Visual Display Terminal

-W-

WDT	Warning Display Terminal
WIN	WWMCCS Intercomputer Network
WIS	WWMCCS Information System
WWMCCS	Worldwide Military Command and Control System

GLOSSARY

Acoustics.
The science of sound, including its production, transmission and effects.

Active security measures.
Active physical security measures include sensors and other devices requiring the consumption of energy after installation or involving human activity for effectiveness. Active measures may deter or delay an intruder. Examples are intrusion sensors and protective lighting.

Airborne sound.
Sound, produced by vibrating sources that radiate sound directly into the air, transmitted through air as a medium rather than through solids or the structure of the building.

Air conditioning.
The control of the humidity, quality, and temperature of the air.

Ambient lighting.
Lighting used to provide general illumination from the ceiling. Luminaires are placed in a modulated plan relative to the building layout. In some circumstances, ambient lighting may not provide adequate light for specific activities; see "task lighting."

Ambient sound.
The continuous existing sound level (background noise) in a room or space, which is a composite of sounds from both exterior and interior sources, none of which generally are identifiable individually by the listener.

Anthropometry.
The study of human body measurement, especially on a comparative basis for ergonomic design.

Background noise.
Normal sound always present in a space created either by outdoor sounds such as street traffic or indoor sounds such as ventilating noise, appliances, etc.

Backlighting.
Illumination from behind used to improve the clarity of a display. Usually used with liquid crystal displays.

Base.
The finish material applied to the intersection of a wall and a floor.

Briefing display subsystem.
A subsystem of the command center system architecture that encompasses graphics workstations, video switches and controller, large screen displays and monitors, video teleconferencing mechanisms, and other audiovisual support equipment. It has connectivity to the backbone network and can provide a path for obtaining digitized graphics developed on information processing workstations.

Cathode ray tube (CRT).
A display device in which controlled electron beams present alphanumeric or graphical data on an electroluminescent screen.

CRT projection.
Direct or reflected projection of a cathode ray tube image.

C-E equipment.
Communications-electronic equipment including all communication-system hardware that provides transmission, receiving, control, and switching. This includes the electrical power-supply system, uninterruptible power system (UPS), batteries, and standby generators essential to the communication mission.

Ceiling membrane.
The suspended ceiling below the floor/ceiling. Provides a finished ceiling surface and accommodates the integration of lighting, HVAC, and partitioning systems.

Closed circuit television.
A TV system in which the transmission of the TV signal is limited to only those receivers that are physically connected to the system.

Command center.
A facility from which a commander and his representatives direct operations and control forces. It is organized to gather, process, analyze, display, and disseminate planning and operational data, and perform other related tasks.

Command and control.
The exercise of authority and direction by a properly designated commander over assigned forces in the accomplishment of the mission Command and control functions are performed though an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission

Command and control system.
The facilities, equipment, communications, procedures, and personnel essential to a commander for planning, directing, and controlling operations of assigned forces pursuant to the missions assigned.

Commonality,
The capacity for subsystem components within any one command center or among two or more command centers, to interoperate.

Common user network.
A system of circuits or channels allocated to furnish communication paths between switching centers to provide communication service on a common basis to all connected stations or subscribers. It is sometimes described as a general purpose network.

Communications security.
Protective measures to ensure the continuity and integrity of information being communicated, as well as the security of the transmission medium. The protection ensures the authenticity of telecommunications and results from the application of measures taken to deny unauthorized persons information of value which might be derived from the acquisition of telecommunications (e.g., encryption and authentication).

Communications subsystem.
The subsystem within the command center system architecture that is made up of the hardware, software, and protocols required to interconnect equipment within the command center and to terminate external communications facilities appearing in the command center.

Construction classification.
Construction classification of buildings based upon the fire resistance of interior and exterior structural-support members, walls, floors and roofs. The construction classifications are Types I, II, III, IV and V, as defined by the Uniform Building Code. Table 1 gives a summary of classifications.

Contrast rendition factor (CRF).
The ratio of visual task contrast in a given lighting environment to the contrast with sphere illumination.

Controlled area.
An area under U.S. Government/contractor control which is accredited for a lower classification than a SCIF but has access limited to U.S. SECRET or higher cleared personnel or uncleared personnel under authorized escort.

Decibel (DB).
A unit for describing the ratio of two powers or intensities, or the ratio of a power to a reference power; in the measurement of sound intensity, the pressure of the reference sound is usually taken as 2/10000 dyne per square centimeter; equal to 1/10 bel.

Defense readiness condition.
A uniform system of progressive alert for use between the Joint Chiefs of Staff and the commanders of the unified and specified commands and for use by the Services. Defense Readiness Conditions are graduated to match situations of varying military severity (status of alert). Defense Readiness Conditions are identified by the short title DEFCON 5,4,3,2, and 1.

Diffuser.
A device for distributing air into a conditioned space, usually mounted in the ceiling system.

Duct.
A conduit made of sheet metal or other suitable material, not necessarily leaktight, used for conveying HVAC, air or other gas at low pressure or wires and cables of the electrical and signal systems.

Electromagnetic pulse.
The electromagnetic radiation from a nuclear explosion caused by Compton-recoil electrons and photoelectrons from photons scattered in the materials of the nuclear device or in a surrounding medium. The resulting electric and magnetic fields may couple with electrical/electronic systems to produce damaging current and voltage surges. May also be caused by nonnuclear means such as lighting.

Electromagnetic radiation.
A series of waves that are propagated by simultaneous periodic variation of electric and magnetic field intensity, including radio waves, infrared, visible light, ultra violet, x-rays, and gamma rays.

Electronic security.
The protection resulting from all measures designed to deny unauthorized persons information of value that might be derived from their interception and study of noncommunications electromagnetic radiations, e.g., radar. (JCSI-DoD) (JCSI-IADB)

Emanation security.
Protection that results from all measures designed to deny any unauthorized persons information of value that might be derived from interception and analysis of compromising (electro-magnetic) emanations from other than crypto-equipment and telecommunications systems (e.g., TEMPEST controls).

Emission security.
That component of communications security which results from all measures designed to deny unauthorized persons information of value

which may be derived from interception and analysis of compromising emanations for crypto-equipment and telecommunications systems.

Equivalent sphere illumination (ESI).
The level of sphere illumination which would produce task visibility equivalent to that produced by a specific lighting environment.

Ergonomics.
The study of human capability and psychology in relation to the working environment and the equipment operated by the worker.

Facilities subsystem.
The subsystem of a command center system that provides the essential shelter and support elements to promote interaction among command center personnel.

Facsimile.
A device which electronically transmits information written or printed on paper, generally used to convey images (facsimiles) of typewritten forms, printed figures, or hand-drawn diagrams to other sites.

Flexibility.
The ability to adjust rapidly to change.

Floor/ceiling assembly.
The construction which separates one floor in a building from another. Does not include the finish flooring nor the suspended ceiling.

Flooring.
The finish material applied to the surface of a floor for durability and appearance. May range in quality from marble tile to asbestos tile.

Footcandle (fc).
The unit of measurement for illumination. Footcandles measure the amount of light falling on a surface.

Guard.
A properly trained and equipped individual whose duties include the protection of sensitive compartmented information facility. Guards whose duties require direct access to a facility, or patrol within a facility, must meet the clearance criteria in the references, but need not be necessarily indoctrinated for access to sensitive compartmented information.

Glare.
The sensation produced by luminances within a visual field when these are greater than the luminance to which the eye is adapted. Glare causes annoyance, discomfort, and loss of visual performance and visibility.

Heating, ventilation, and air conditioning (HVAC).
The process of simultaneously controlling the temperature, relative humidity, cleanliness, and motion of the air in a space. The term HVAC is synonymous with the term environmental control.

Human-factors engineering.
The area of knowledge dealing with the capabilities and limitations of human performance in relations to design of machines, jobs, and other aspects of the human's physical environment.

Impact noise rating (INR).
A single number rating used to compare and evaluate performance of floor/ceiling construction in isolating impact noise transmission.

Information processing subsystem.
A subsystem of a command center system with functionality that is expected to be distributed to the extent permissible within security constraints. Local area networks exist in the individual command center work spaces and user workstations have access to all user functionality.

Lighting effectiveness factor (LEF).
The ratio of equivalent sphere illumination (ESI) to measured or calculated task-illuminance.

Liquid crystal display (LCD).
A display made of a substance whose transmittance and reflectance changes when an electric field is applied.

Luminance.
The quotient of the luminous flux at an element of the surface surrounding the point and propagated in directions defined by an elementary cone containing the given direction, divided by the product of the solid angle of the cone and the area of the orthogonal projection of the element of the surface on a plane perpendicular to the given direction.

Local area network.
A system linking together computers, word processors and other electronic office machines to create an inter-office or intersite network.

Masking sound.
The effect produced by background noise which appears to diminish the loudness of transmitted noise.

Modular.
Constructed with standardized units or dimensions for flexibility and variety in use.

Modularity.
The degree to which system components could be separated into functional and equipment "building blocks."

National military command system.
The NMCS is the priority component of the WWMCCS designed to support the NCA in the exercise of their responsibilities. It also supports the JCS in the exercise of their responsibilities.

Noise reduction.
Reducing the level of unwanted sound by any of several means of acoustical treatment.

Noise reduction coefficient (NRC).
A single number index of the noise reducing efficiency of acoustical materials. It is found by averaging the sound absorption coefficients at 250, 500, 1000 and 2000 cps.

"No-lone zone" or two man concept.
This pertains to all facilities where SCI is stored or processed and requires that when the facility is in use, no fewer than two appropriately cleared personnel are present.

Operations security.
Conformance with specified operating doctrine to preclude enemy acquisition of useful, sensitive information.

Partitions.
Any building assembly that separates one area from another in the horizontal plane and is non-load-bearing.

Passive Security Measures.
Passive security measures are those which do not consume energy after their initial installation. Included are barriers, walls and hardening measures that delay or deter intruders.

Perimeter Alarm System.
A warning system which detects entry or attempted entry through the walls, doors, windows, vents and/or other perimeter openings and, if required, the floors and ceilings of a facility.

Plasma display.
Flat plate display which uses an ionized gas to convert electrical energy to light.

Projection size.
Size of the BDS projected image, expressed typically in length * width, or diagonal measure.

Prototype.
A model suitable for use in complete evaluation of form, design, performance, and production potential.

Rack.
A vertical frame on which one or more units of C-E equipment are mounted.

Reverberation.
An effect or impact that resembles an echo. Reverberations tend to "mask" the original sound source if they are excessive; see sound attenuation.

Secure working area.
An accredited facility which is used daily for handling, discussing and/or processing of sensitive compartmented information, but where such information is not stored.

Sensitive compartmented information facility (SCIF).
An area, room, group of rooms, or installation which has been accredited by authority of the references for storage, discussion and/or processing of sensitive compartmented information.

Sound absorption.
The ability of a material to absorb rather than reflect sound waves striking it by converting sound energy to heat energy within the material.

Sound attenuation.
Diminution of the intensity of sound energy propagating in a medium; caused by absorption, spreading, and scattering.

Sound isolation.
Materials or methods of construction designed to resist the transmission of airborne and structure-borne sound though walls, floors and ceilings.

Sound transmission.
The passage of sound through a material construction or other medium

Airborne sound transmission:
Sound transmitted when a surface is set into vibration by the alternating air pressures of incident sound waves.

Structure-borne sound transmission:
Sound transmitted as a result of direct mechanical contact or impact caused by vibrating equipment, footsteps, object dropped, etc.

Sound transmission class (STC).
A single number rating for evaluating efficiency of construction in isolating airborne sound transmission. The higher the STC rating the more efficient the construction.

Specific command.
A command that has a broad continuing mission and is established and so designed by the President through the Secretary of Defense with the advice and assistance of the Joint Chiefs of Staff. It normally is composed of forces from but one Service.

Task lighting.
Lighting used to provide specific illumination for a particular task (or activity). The fixtures are usually adjustable and movable, and are always controlled by the individuals doing the tasks.

Technical assessment/cost estimate.
A document developed by a command to present technical alternatives for upgrades to C3 systems, the costs associated with each.

TEMPEST.
The term "TEMPEST" flags the system as processing information related to national security and establishes the need for additional site specific facility alternations and improvements.

Teleconferencing.
A conference between two or more persons remote from one another but linked by a telecommunications system.

Terminal.
A computer peripheral device, local or remote, hard copy or electronic, providing basic input and output capabilities, having very limited intelligence, stored programs, and data storage.

Throw distance.
Throw distance is the distance along the projection axis from the front of the projection lens to the screen surface.

Unified command.
A command with a broad continuing mission under a single commander and composed of significant assigned components of two or more Services, which is established and so designated by the President, through the Secretary of Defense with the advice and assistance of the Joint Chiefs of Staff; or, when so authorized by the Joint Chiefs of Staff, by a commander of an existing unified command established by the President.

Uninterruptible power supply (UPS).
A power source that will perform without interruption, providing protection against primary a-c power failure, and against variations in power-line frequency and voltage.

UNIX.
A disk operating system developed by AT&T that is more "powerful" than those previously used.

Usability.
The ability to satisfy a defined need in a clear, comprehensive, and readily operable way from a human viewpoint. It includes ease of use, as well as management, operator, and user acceptability.

Vault.
A room or group of rooms constructed to meet the vault specifications as prescribed by federal or departmental regulation.

Visual comfort probability (VCP).
The rating of a lighting system expressed as a percent of users who can be expected to find the system acceptable in terms of discomfort glare -- when viewing from a specified location and in a specified direction.

Workstation.
The complete set of functional components (furnishings and equipment) that are necessary for a particular work position; i.e., a 'task setting.

WWMCCS information system.
The system that will be acquired primarily to replace elements of the current WWMCCS ADP system, including the Joint Reporting Structure, the operational reporting procedures, formats, and executive aids.

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Defense Information Systems Agency



Joint Tactical Command, Control and Communications Agency

COMMAND CENTER DESIGN HANDBOOK

Volume 3:
Command Center Subsystems

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PART 1. INTRODUCTION TO VOLUME 3

PURPOSE OF VOLUME 3

This volume, the last of three in the Command Center Design Handbook, provides information on command center technology to aid in planning, design, and acquisition tasks in support of command center improvements. The information it provides falls into three categories:

- A summary and discussion of the command center system architecture. This architecture is the conceptualization of command and control resources and facilities that underlies the process by which command centers are currently developed and enhanced.
- Practical guidance about technologies within the four command center subsystems. This discussion addresses what these technologies are and how they operate, the standards that govern them, and how they can be applied in the command center environment.
- Specific data on equipment components in each of the technology areas. This includes information on existing defense communications programs, government-owned and commercial off-the-shelf hardware and software (now collectively referred to as non-developmental items, or NDI), and "stovepipe" systems currently operating in command centers. Program and product data for each subsystem is included in a "yellow pages" section at the end of each major part of the document.

With these three types of information, the reader can design a technical solution to an operational deficiency in a command center. Using the other volumes of the CCDH to identify deficiencies and manage project implementation (Volume 1), and to develop an integrated picture of the command center from a functional perspective (Volume 2), the reader is prepared to meet the challenge of creating a command center that is mission-responsive, habitable, and interoperable.

INTENDED USERS

The CCDH as a whole is directed toward the command center community of the National Military Command System, the unified and specified commands and their component commands, and the subunified commands. Volume 3 is intended for use by the personnel who operate communications, information processing, or briefing and display equipment in the command center as part of their primary job function, and for those who manage or provide input to command center enhancement efforts. Because its focus is technology, and because the Joint Staff increasingly emphasizes the use of commercial or non-developmental products, Volume 3 is useful to persons outside the command center community as well. Individuals conducting research on command and control mechanisms, and those seeking generic information on any of the technologies covered in this volume, will find the CCDH an excellent starting place.

Advanced technical knowledge on the part of the reader of the CCDH is not presumed; however, familiarity with command center operations and equipment will help the reader apply in a meaningful way the information that is presented in this volume.

EVOLUTION OF THE DOCUMENT

The Command Center Design Handbook is a "living document"; its viability over time depends on frequent data updates and modifications in scope as command centers, defense policies, and technologies change. Because new generations of computer hardware and software emerge so frequently, and new solutions to command center problems — and new challenges — are constantly being found, the information in Volume 3 is particularly perishable. It will be kept current in the short term through the distribution of change-pages when corrections are required or when additional data becomes available. Periodic complete updates will be scheduled to coincide

with the revision of key Joint Staff policies such as the command center system architecture. Feedback from the user community is welcome at any point in the process.

INFORMATION RESOURCES RELATED TO COMMAND CENTER TECHNOLOGY

As a product of the Command Center Initiatives Program, the CCDH is one of several information resources available to the command center community. Readers may wish to investigate the CCIP's other programs and publications:

- Using input from command center staff to determine evaluation criteria, the Demonstration and Technical Survey (DTS) Program evaluates commercial products in a narrowly defined technology area that are suitable for command center applications. Open demonstrations are held, and a factsheet providing background on the topic and results of the evaluation is published. This information will be carried over and included in summary form in the CCDH. Past DTS initiatives have examined optical scanning and electronic mapping equipment.
- Contract Summaries focus the attention of the user community on existing contracts that can be used to acquire equipment or services. Each summary outlines one contract and lists eligible purchases, points of contact, limitations, and ordering instructions. Because the Multicommand Required Operational Capability for Command Centers (MROC 1-89) calls for indefinite-quantity contracts, the Contract Summaries aspect of CCIP will play an increasingly active role in command center upgrades.
- Commands may request that "Tiger Teams" of technical experts evaluate their facilities and operations to pinpoint problem areas and recommend solutions. Teams are assembled according to the requesting command's specific needs; they may include experts in ADP, audiovisual technology, facilities, or other areas.
- CCIP periodically sponsors conferences and workshops. These events offer participants an opportunity to exchange ideas and hear from experts in several fields.
- CCIP's INSIGHT newsletter publicizes events of interest and communicates news to and from command center staff.

Command center personnel can obtain information and receive assistance in addition to that offered through CCIP channels. The National Security Agency's leadership in information security, the Defense Mapping Agency's electronic mapping programs and products, and the efforts of the various Service laboratories all provide benefits to the command center community. In addition, as defense organizations increasingly implement COTS products, a wide range of non-DoD support services becomes available to them. Users' groups organized around one brand of hardware or software or a particular operating system are an example. Computerized bulletin boards, technical magazines, and commercial training courses offer additional opportunities to learn and enhance skills.

PART 2. THE COMMAND CENTER SYSTEM ARCHITECTURE

THE COMMAND CENTER SYSTEM ARCHITECTURE

Origin and Purpose

Because a command center performs a specific, individual mission, its detailed operational requirements cannot be identical to the requirements of another command center that serves a different purpose. However, some operational requirements–the need for information sharing among staff elements within the command center, for example–are common to all command centers. This commonality has been expressed in several publications. Common operational requirements and deficiencies are described in the Requirements Submission-Multicommand and the *Multicommand Required Operational Capability (MROC) 1-89 for Command Centers*. Although a command center's requirements for an upgrade must be related to deficiencies specifically at that site, these documents represent an attempt to ensure that certain problems common to most or all command centers are solved in a similar way and with a minimum of redundant effort.

The *Command Center System Architecture and TA/CE Guidance* document promotes commonality by examining the generic command center as a system comprising four interrelated subsystems, as shown in Figure 2-1. It presents a top-level architecture that describes various components and capabilities and maps the relationships between these elements. In addition, it encourages the planners of command center improvements to address continuing techno-

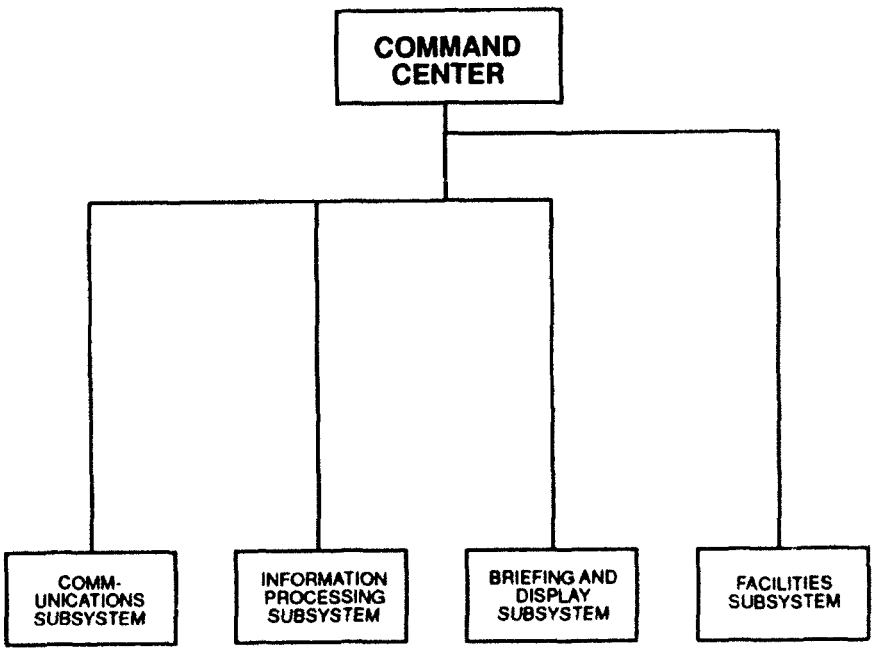


Figure 2-1. Command Center Subsystems

logical advancement by looking at the architecture from two perspectives. Thus, a target architecture is defined, indicating a set of capabilities that is expected to be fully achievable in 1995 and to which all improvements begun now should be upgradable. A current architecture is also defined. The term "current architecture" does not describe what any particular command center has in place at the moment, but rather describes a standard plan based on existing technology that improvement projects undertaken today (or at any time until the capabilities proposed in the target architecture are realized) should follow. At the highest level of detail, the target and the current architecture are identical. The information in the following paragraphs is applicable to both.

Because the command center system architecture must reflect growth in technology in order to remain useful, the document that communicates the architecture must also change. The FY 1992 edition of the *Command Center System Architecture and TA/CE Guidance* will therefore extend the timeframe of the target architecture to 1997; the current architecture will describe what is attainable in 1992. Each edition of the CCDH, in turn, will build upon the foundation presented in the architecture in force at the time of the CCDH's preparation.

Volume 3 of the CCDH derives its structure directly from the FY 1991 command center system architecture. However, because in some cases the architecture document does not discuss particular technologies or components in detail, and because the organization of the theoretical information in the architecture document does not lend itself to a practical discussion in the CCDH, some changes have been made. Figure 2-2 shows the structure provided by the architecture and the modifications to it that are reflected in the CCDH. Figure 2-3 concerns the CCDH exclusively; it shows the modified format and provides chapter references for each topic.

Overview

According to JCS Pub.1, a command center is "a facility from which a commander and his representatives direct operations and control forces. It is organized to gather, process, analyze, display, and disseminate planning and operational data and perform other related tasks." The tools and mechanisms for performing these tasks are organized into four subsystems: three information-related subsystems - communications, information processing, and briefing and display – and the distinct but equally important facilities subsystem.

The major components of the information-related subsystems will be connected electronically by a backbone network, as shown in Figures 2-4 and 2-5. Interaction across these subsystem boundaries is essential to command center operations. The optimal command center described by the target architecture is one in which personnel or equipment components that need to interoperate can do so easily. In addition, mission performance requires connectivity between elements within the command center and elements outside the facility.

The Subsystems Defined

Communications

The communications subsystem comprises the hardware, software, and protocols required to terminate all external voice, video, and data resources in the command center. Voice is the principal product distributed within the command center, and the primary user interface is telephone equipment.

Information Processing

The information processing subsystem (IPS), which distributes data throughout the command center via workstations, encompasses network management, database servers, and user applications. It also includes local area networks (LANs) distributing information within command center work spaces. User workstations, which provide access to all user functions, have access to a mix of vendor products that are interoperable because they meet specific standards. Servers and peripheral devices are included in this subsystem, but the need for specific components varies, depending on security and performance requirements.

Briefing and Display

The briefing and display subsystem (BDS) distributes video and associated audio within the command center, primarily by means of large screen wall displays and loudspeakers or other sound system components. Components of this subsystem include graphics workstations, video switches and controllers, large screen displays and monitors, video teleconferencing devices, and other audiovisual support equipment. The video switch allows graphics produced by the IPS to be presented on BDS display mechanisms, and also permits security control of presentation materials.

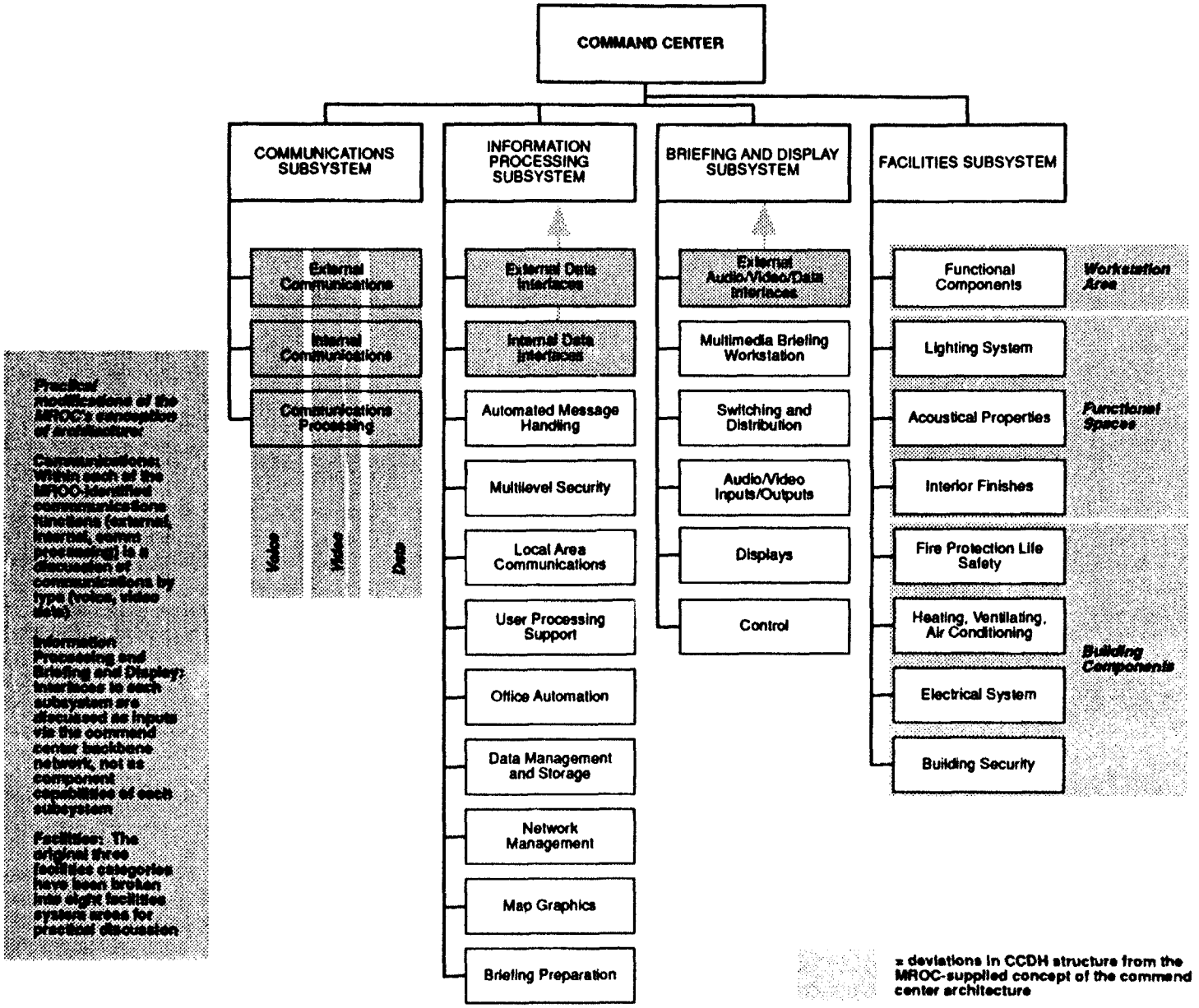


Figure 2-2. The Command Center System Architecture, As Reflected in the CCDH

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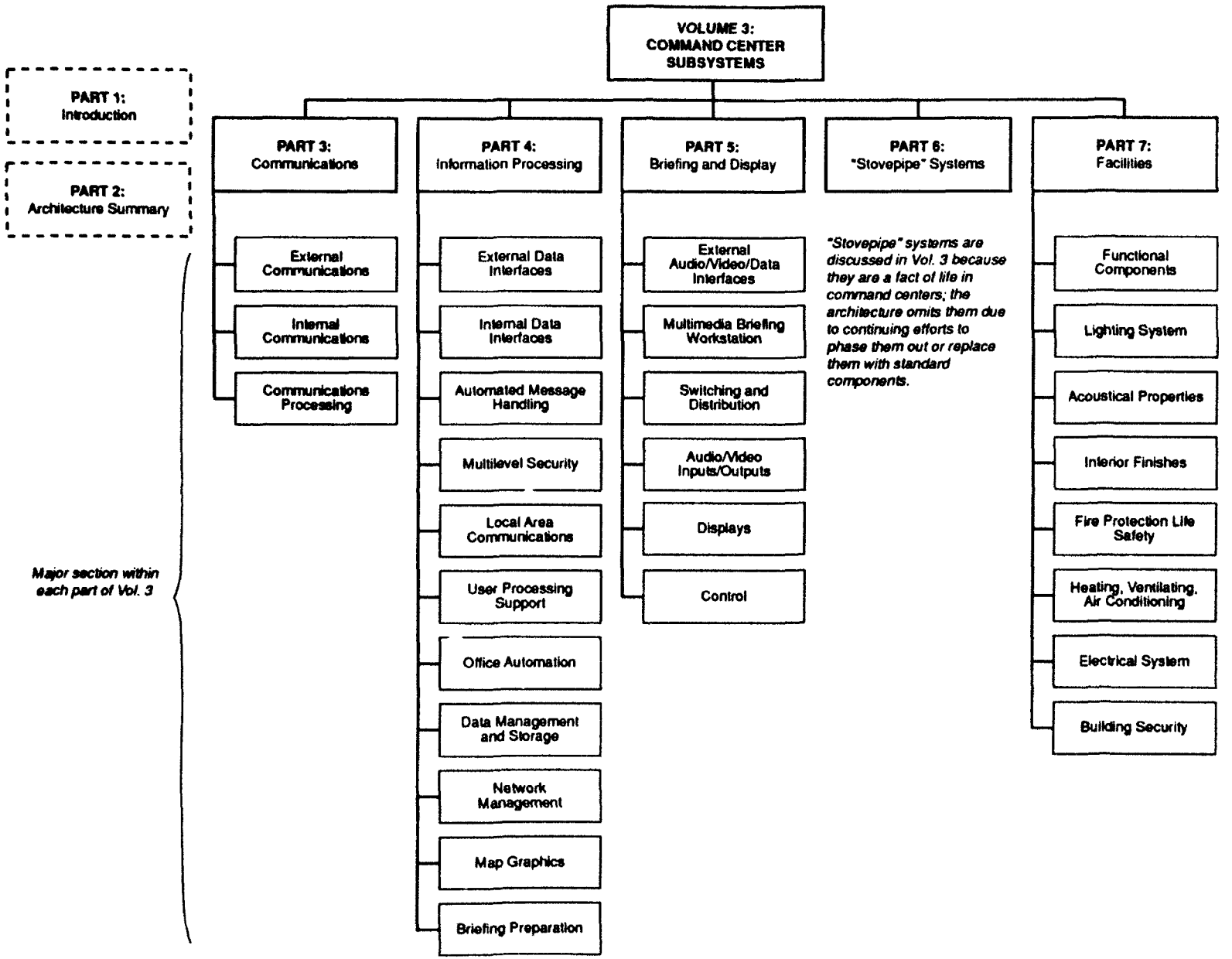


Figure 2-3. Resulting Structure of the CCDH

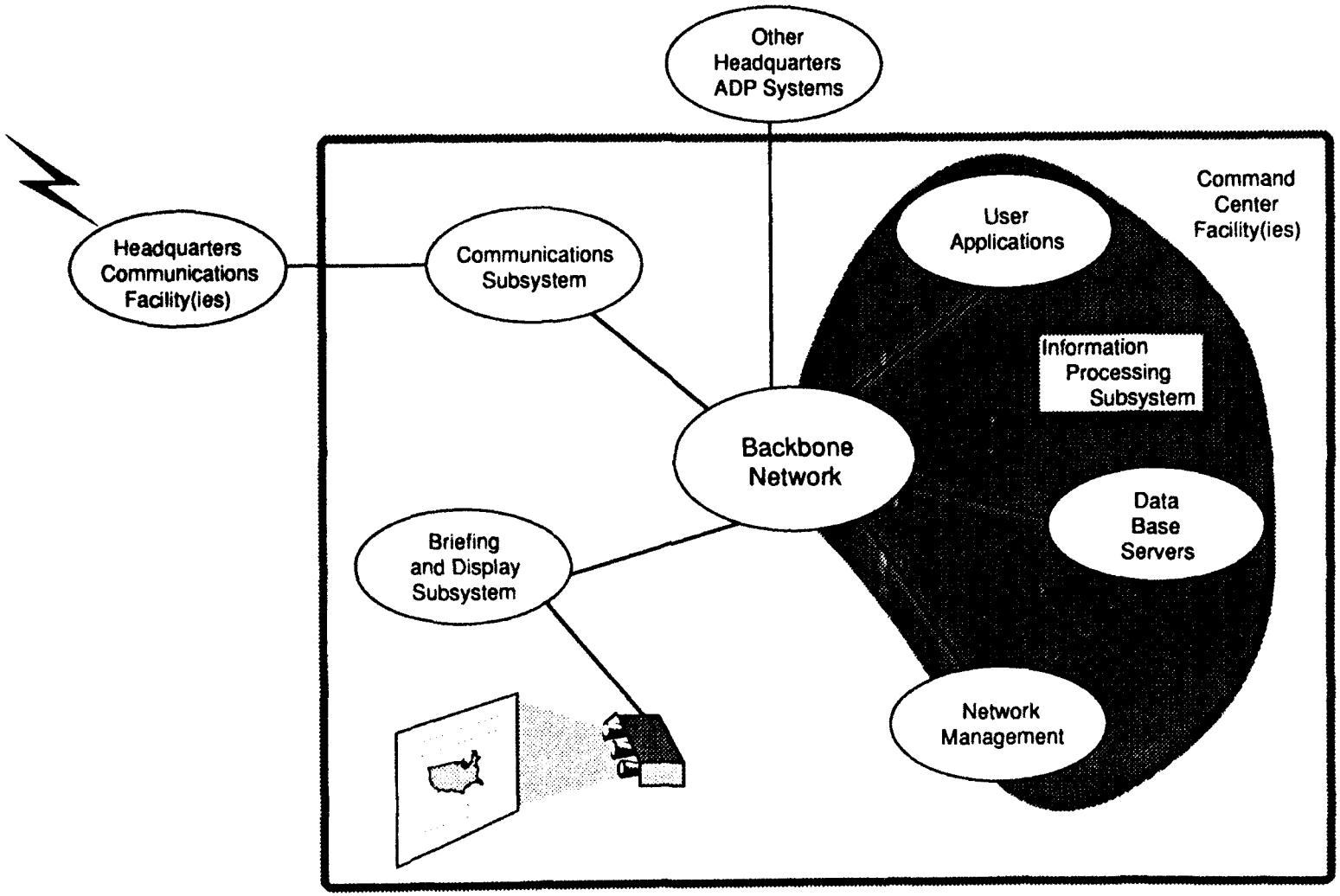


Figure 2-4. Command Center Architecture Components

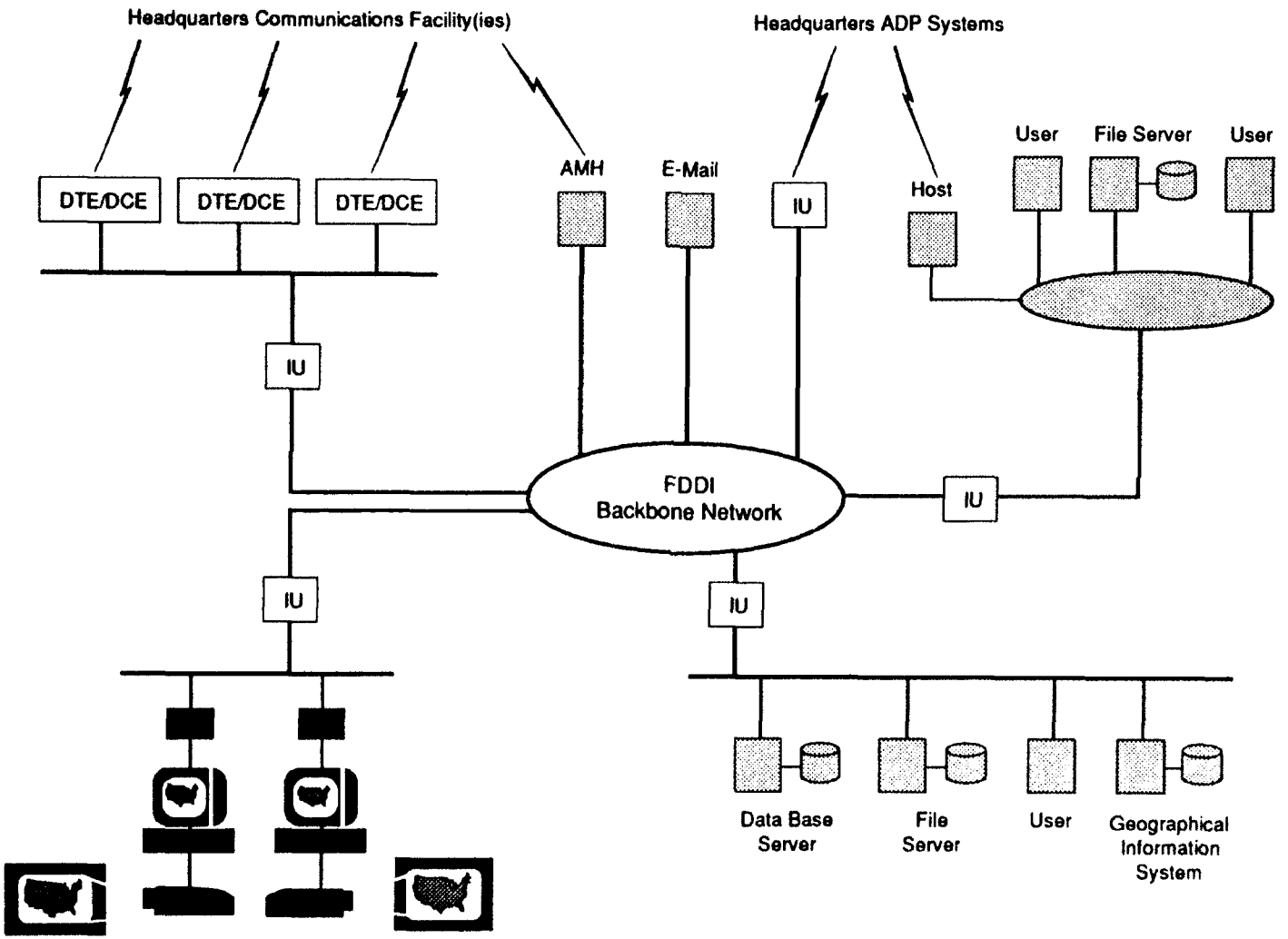


Figure 2-5. Backbone Network Linking the Subsystems

Facilities

The facilities subsystem physically accommodates command center personnel and equipment and supplies essential comfort and support mechanisms for them.

System Characteristics and Issues

The conceptual view of the command center as a system made up of subsystems mandates that the command center's requirements and configuration be examined from a unified perspective, as well as on a subsystem-by-subsystem basis. Information exchange, security, physical factors, and general characteristics such as connectivity and survivability deserve consideration from both points of view.

One of the most important issues concerning the command center system architecture is determination of the outside boundary of the architecture, and the delineation of boundaries between subsystems. Specifically, the exclusion or inclusion of particular components in the target architecture is not clearly defined.

Another issue is the impact of emerging technologies and new products on the command center system architecture and how newly developed capabilities and functions will be integrated into the subsystems. Future developments will no doubt provide opportunities to improve the architecture. Conversely, a lack of progress in a specific area might delay the implementation of the target architecture beyond the projected 1995 date. As new components become available, the relationship between the new and existing systems will need to be determined and interfaces between them engineered. Ways to maintain continuity of operations while replacing or upgrading subsystem components are also needed.

The command center system architecture has been developed with the assumption that all personnel working within the command center have top secret/special background investigation (TS/SBI) clearances, and that not all personnel will be granted formal access to all compartments. Operation at security levels higher or lower than that assumed in the architecture will necessitate tailoring the security requirements for certain components and spaces. Non-multilevel security (MLS) methods to control security must be maintained until MLS becomes a reality. The architecture makes provisions for the current state of MLS technology and will incorporate technological advances as they occur.

COMMUNICATIONS SUBSYSTEM ARCHITECTURE

Operational Requirements

The major operational requirement for the communications subsystem is to carry voice, data, and video traffic between the command center and external facilities, as shown in Figure 2-6. The subsystem must meet the real-time performance requirements and security requirements of the traffic carried. External communications require the ability to interface with, and communicate via, a variety of radios, satellite systems, dedicated voice and data lines, and defense networks. Also required are interfaces to special networks unique to the unified and specified commands and commercial networks. Internal communications require switched communications for voice, record, and video traffic, as well as data distribution networks. The switched communications systems for voice will include secure telephones, nonsecure telephones, and intercom service, with traffic carried over common-user, dedicated, and special CINC-unique circuits in secure and nonsecure modes. Data distribution within this subsystem will be achieved through the communications subsystem LAN. (The subsystems themselves are linked by a backbone LAN, which is part of the information processing subsystem.) Communications processing will involve system interface conversions, protocol conversions, system monitoring, and maintenance testing. In crisis situations, the capability for rapid system reconfiguration will also be required. Special-purpose information processing could also be required for surveillance, warning radars, and the dissemination of Emergency Action Messages (EAMs).

Target Architecture

The objective of the target architecture is to develop the communications subsystem in a modular fashion, using an open system architecture and a set of suitable communications interface specifications and standards. This approach permits the use of equipment from different vendors and the introduction of advances in technology. It also provides a framework for required command center communications services. The architecture assumes the availability of digital, integrated communications services for external communications and high speed LANs for internal communications. The target architecture is depicted in Figure 2-7.

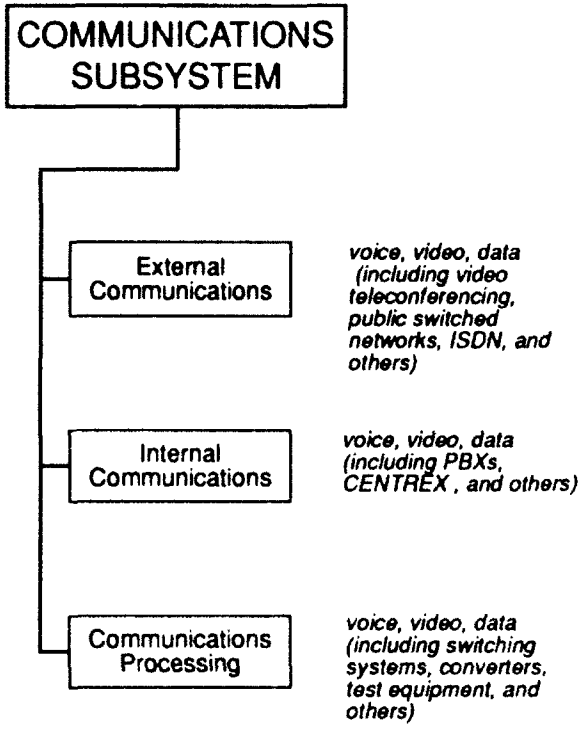


Figure 2-6. Communications Subsystem Required Capabilities

Current Architecture

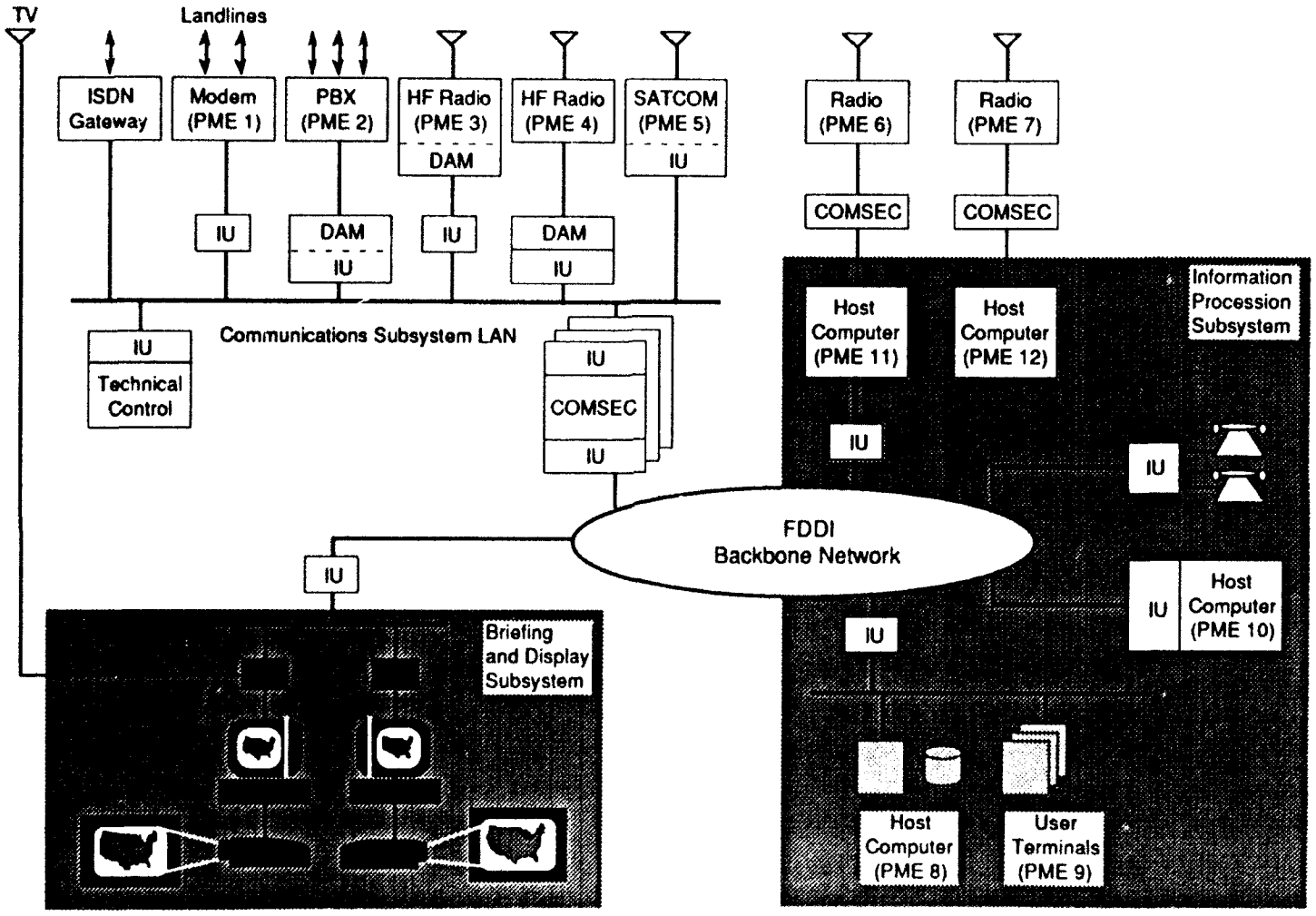
The current architecture provides a logical migration path to the target architecture. The current architecture is based on available standards and equipment, with interfaces to all present external communications systems, requiring no additional external communications systems.

In the past, separate communications components provided data, voice, and video traffic. As digital services provide an increasing amount of all types of traffic, the distinctions between data, voice, and video are fading. The current architecture categorizes communications as external, internal, and communications processing as a first step in coming to terms with the new class of integrated services and components; however, the traditional categories of voice, data, and video cannot yet be eliminated.

Voice traffic is handled in the current architecture by separate secure and nonsecure digital switch networks (Red/Black), with a Red/Black controller that connects Red/Black telephones to either the Red or Black digital switch. The switch also converts and reconverts analog to digital to accommodate analog equipment. An audio/video display interface is provided by the Emergency Action Console (EAC) to show calls or operations in process, calls waiting, and various information and status indications.

Video traffic is received as a modulated video signal and is then converted to a baseband signal before being fed to the IPS or BDS for further processing. Currently, typical video applications include video teleconferencing, transmission of computer generated images, and broadcast television.

The thrust of the communications subsystem current architecture is interoperability between command centers. The architecture is designed to be modular and flexible to encourage evolution to the target architecture. Although the availability of all digital voice devices and interfaces is anticipated, in the current timeframe analog and digital telephone equipment will continue to be used. During this interim phase, command centers are encouraged to concentrate on maximizing equipment commonality and standardizing currently used protocols and interfaces.



IU = Interface Unit (e.g., bridge, gateway, BUI)

Figure 2-7. Communications Subsystem Target Architecture

INFORMATION PROCESSING SUBSYSTEM ARCHITECTURE

Operational Requirements

The information processing subsystem is designed as an open system that supports interoperability and a cooperative processing capability through the use of defined standards among all networked resources. Minimally, the common required operational capabilities that must be supported by the command center IPS architecture include the following: external and internal data interfaces, automated message handling, multilevel security, local area communications, user processing support, office automation, data management and storage, network management, map graphics, and briefing preparation. These capabilities are graphically illustrated in Figure 2-8 and discussed as major sections of Part 4 of this volume.

Target Architecture

The information processing target architecture, shown in Figure 2-9, is an open architecture that facilitates networked services and user applications. It is based on the client/server model in which a client application executing on one platform requests the services of another platform in a cooperative manner. Internal data communications are provided by multiple LANs, interconnected by the high-speed fiber-optic backbone network. LANs convey all data and voice traffic among mission equipment, and between mission equipment and technical control. The IPS subsystem LAN will connect the IPS equipment. The major backbone LAN, which will be fiber-optic and will meet the emerging Fiber Distributed Data Interface (FDDI) II standard, will connect the three information related-subsystems in the command center. Interface units (IUs), implemented on an industry-standard backplane bus, will bring voice and data signals to the LAN and, along with the LAN, will provide the open architecture platform needed to expand, reconfigure, and interface to a wide variety of mission equipment. Although the availability of multilevel security (MLS) LANs and interface devices are assumed, if the technology is not available, current security approaches will be retained.

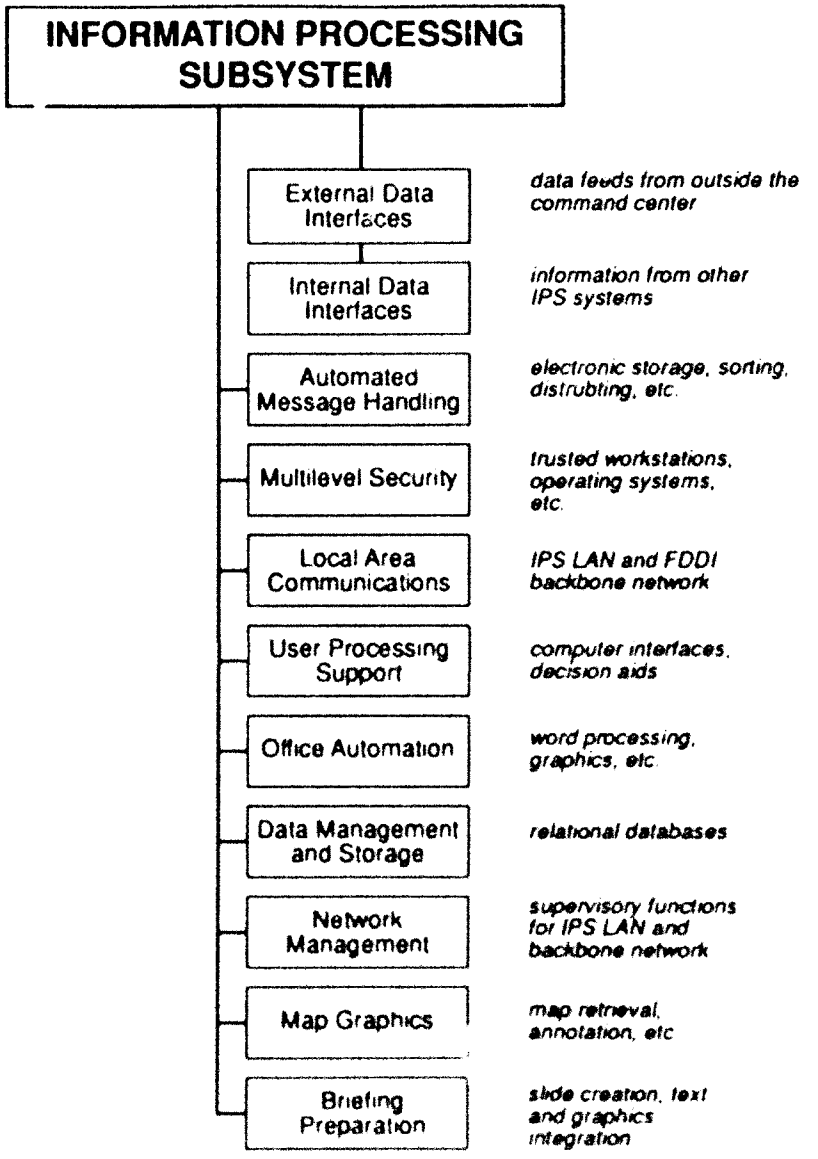


Figure 2-8. Information Processing Subsystem Required Capabilities

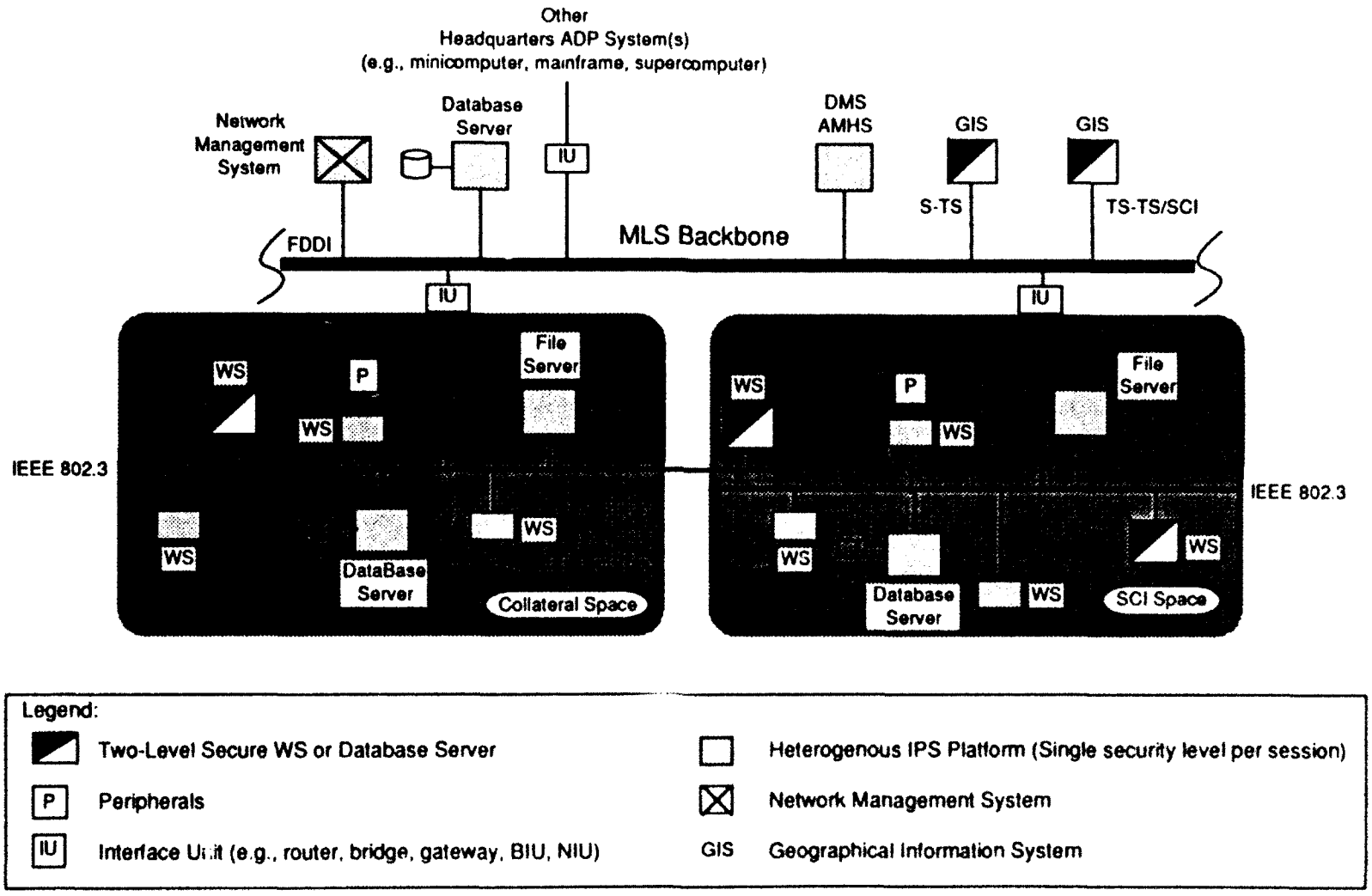


Figure 2-9. IPS Target Architecture

The architecture is an open system based on and guided by a set of international, industry, and government standards and is minimally dependent on proprietary technologies, which ensures a more robust system. The subsystem's platform suite is based on proven, mature technologies achieved through the increased use of non-developmental components. As requirements and technologies evolve, command centers can migrate their hardware and software with minimal interruption to their mission and, with scrutiny and careful management, integrate multiple technologies.

By adhering to several basic principles, the IPS architecture is designed to provide a migration path to a more common command center computing environment. The architecture easily adapts to local command needs and provides support for current computer platforms, improved portability of applications and data, and improved intra- and inter-operability. The availability of Government Open Systems Interconnect Profile (GOSIP), the government-developed set of computer system standards, offers a focus for standardization. The open architecture can accommodate existing command center information processing configurations and support migration to the target architecture by increasing connectivity among heterogeneous computers and improving data exchange. Improved heterogeneous data exchange is also improved by the architecture's adherence to defined standards. By achieving cooperative processing, the architecture supports the distribution of processing power equitably among networked computers. An increased use of NDI reduces the number of proprietary systems and eliminates the current gaps in information processing. The subsystem architecture does not dramatically alter existing subsystem behavior, but it provides guidelines for expansion and introduction of command center-wide standards. It will be a cooperative, distributed computer environment in which networks of computers share computing resources and responsibilities based on user and computer capabilities.

Current Architecture

The information processing subsystem current architecture is the stepping stone to the target architecture. It is based on an evolutionary approach in which the path toward the target architecture is initiated, a minimal set of new technologies and standards are introduced, and command centers begin to manage the migration from current technologies to GOSIP-based technologies.

The major components of the current architecture are the same as for the target architecture except in the selection of current technologies, standards, and products. An important feature of both architectures is the interconnection of most command center computer resources. A high-speed, dual counter-rotating ring, FDDI-based backbone is required to support the potential high volume of data transfers. Advances in LAN and backplane bus connectivities are the primary difference between the current and target IPS architectures. Each command center will have to determine, based on specific needs, which equipment will be linked by a network today, and then plan to network the remaining equipment by the next upgrade. The current absence of accredited MLS technologies also necessitates the use of encryption units with paired lists of recipients to provide a logical separation of data and support sharing the LAN among systems operating at different security levels.

The backbone network is defined in the current architecture as FDDI standard fiber-optic. Data traffic is carried among the mission equipment, and between the mission equipment and technical control via a LAN; it also flows between computers and user terminals within the command center. The backbone network feeds information intended for briefings into BDS systems from communications connections, in the case of teleconferencing feeds and other traffic that is used as it arrives from outside the command center. Information generated or processed on IPS systems also travels to the BDS on the backbone LAN. Encryption units, connecting to the LAN and the backbone network via an interface, will provide communications security for the LAN. VMEbus technology will provide connectivity between the backplane bus and the various devices. Two-way, encrypted traffic is carried by the communications LAN, through communications security devices. The control and monitoring of data traffic, between technical control and mission equipment, will be handled by a device adapter module (DAM) for remote control.

BRIEFING AND DISPLAY SUBSYSTEM ARCHITECTURE

Operational Requirements

The primary required operational capability of the briefing and display subsystem is to provide graphic and data displays to decision makers, in

support of briefings that are intended to aid timely decision making. The subsystem must distribute all required images, using a combination of centralized and local audiovisual control, to critically placed monitors and large screen group displays located throughout the command center. Access to these images is based on a need to know and will be in real time.

The component capabilities of the briefing and display subsystem include external audio/video/data interfaces, switching and distribution, audio/video inputs and outputs, display, and control. A major component of the subsystem is the multimedia workstation, which will provide command center staff with easy access to images of all types, text, sound, and motion video. These capabilities are graphically illustrated in Figure 2-10. When the subsystem is integrated into the command center system, it will provide the basic capabilities to display computer-generated, high-resolution images from the IPS; live and stored television images; BDS-generated images on user monitors; and secondary, nonvideo images. It also will provide hard copies of video graphics and have the capability for audio and internal/external video teleconferencing. It will be capable of storing and playing back selected television sequences and freeze-frame graphics, as well as allowing the local viewer to select display images.

There are also more specialized requirements that exceed the minimal capabilities. Large screens and carefully considered room designs are needed to position viewers away from images at correct distances. Video distribution systems of sufficient bandwidth are needed that display high-resolution, computer-generated graphics equal to the original source's image quality. Two additional requirements are central and local control system designs that permit images from alternative video sources to be displayed and presentation systems that permit briefers to access images created from workstations within the IPS.

Target Architecture

The target BDS architecture, shown in Figure 2-11, will support analog and digital transmission of image information via an all fiber-optic system from the source of the image to the final display destination. It will incorporate a wideband video distribution system that will ultimately provide decision makers with displays that are legible, graphically understandable, and rapidly changeable. It is expected that the exclusive use of fiber optics for transmission and distribution will accommodate the increased resolution of computer-

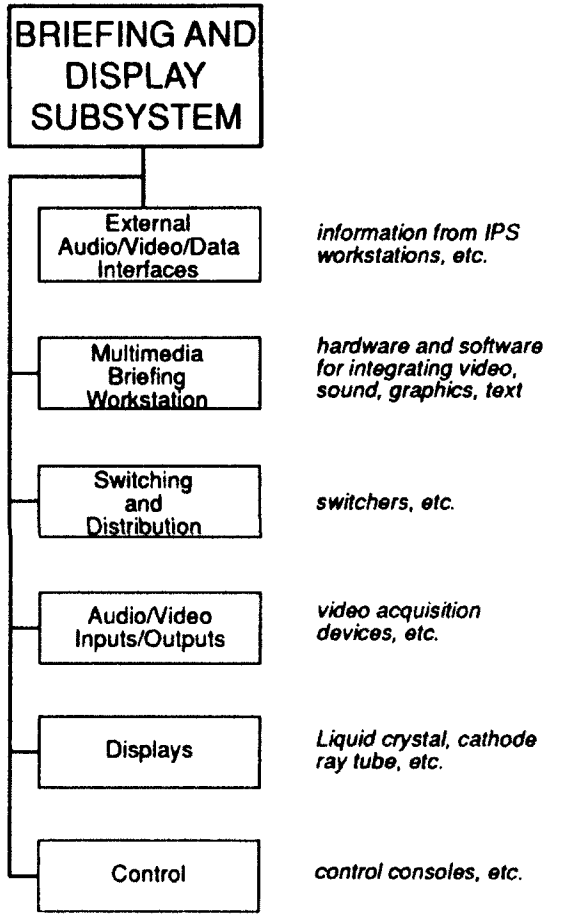


Figure 2-10. Briefing and Display Subsystem Required Capabilities

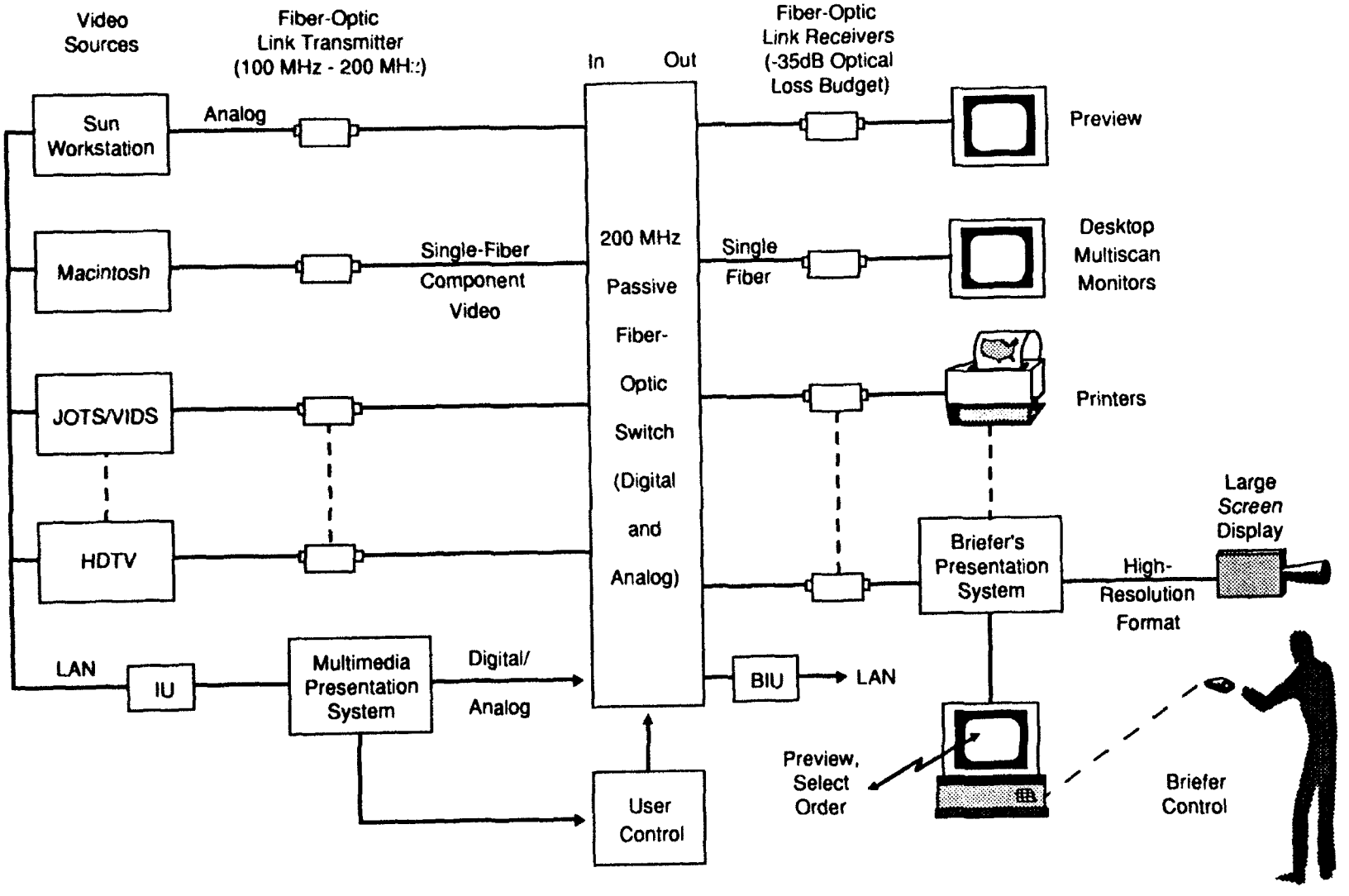


Figure 2-11. Briefing and Display Subsystem Target Architecture

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generated graphics. The design of the subsystem is simple but is coupled with the potential for virtual unlimited bandwidth.

The subsystem will be designed based on three major components: a fiber-optic distribution switch, single-fiber component-video transceivers, and a multimedia presentation system. To achieve this architecture and use these components, several technological issues must be addressed. Fiber-optic switches use optical splitters that cause a loss of sensitivity and a reduction in the signal; more highly sensitive transceivers are currently being evaluated to overcome this limitation. The display of computer-generated images from the IPS over the LAN is limited by the LAN's technology; bandwidth required to transmit analog high-resolution graphic images is very high and display units able to accept digital information directly from a LAN are not available, although some elements of the multimedia presentation system exist today as frame buffers or image processors.

Current Architecture

The primary source of images to be distributed and displayed by the briefing and display subsystem will be high-resolution computer-generated images from the IPS. Additional sources of images include TV signals, both stored and live; video teleconferencing; and graphics created within the BDS. Additionally, it may be necessary to support nonvideo images, including the display of viewgraphs and 35 millimeter slides, and provide for the generation of paper copies of images.

The current architecture requires the connection from image sources, which have been identified for display by command center personnel, to video distribution switches. The display sources will be connected via wideband cabling to the switches. The architecture also requires connection from the video distribution switch to the video monitors, large screen projectors, image storage units, and video printers. A parallel audio capability permits transmission of TV audio, and internal and external video conferences will be supported. The architecture is tied together by a control system that functions to permit the distribution of all video inputs to all output displays by use of a centralized "master control" unit and by local selectors or controllers at each display unit. The master control system controls the video switches and, where necessary, provides automatic selection of a projector channel for each video signal.

As part of the current BDS architecture, certain design issues were considered. Wideband fiber-optic video transceivers for long distribution cable lengths are recommended. Wideband, three-level red-green-blue (RGB) component-video switches that will not degrade the highest resolution signal are called for. Separate special compartmented information (SCI) and collateral video distribution switches meeting industry standards for high-resolution video are needed. Also recommended are video monitors and projectors that provide an advanced multisynchronization capability. Associated concerns that should not be overlooked include the selection of screen sizes and decision spaces that position decision makers an optimum distance away from images to ensure eye acuity, and a briefing display control system that permits images from alternative sources to be displayed with minimal delays. A provision for a basic presentation capability that permits briefers to preview, store, and rapidly access images created by several workstations within the IPS is also recommended.

FACILITIES SUBSYSTEM ARCHITECTURE

Operational Requirements

The facilities subsystem supports the communications, information processing, and briefing and display subsystems. It ensures that the necessary shelter and support elements, such as raised floors, lighting, and furniture, are available to allow the capabilities of the information-related subsystems to be realized within the command center facility.

The operational requirements for the facilities subsystem are to provide functional support such as physical layouts that facilitate information flows, to support the rapid alteration of work spaces through the use of modular furniture components, and to support the security of command center operations with appropriate security equipment and procedures. These requirements are satisfied by eight components of the facilities subsystem architecture. These elements are:

- Functional components
- Building security
- Interior finishes

- Acoustical quality
- Lighting system
- Heating, ventilation, and air conditioning system
- Electrical system
- Fire protection/life safety system.

These eight components are an elaboration of the three divisions presented originally in the MROC; the conceptualization of these eight facility factors is deemed more approachable and better suited to a practical discussion of facility concerns. The eight areas are shown in Figure 2-12.

Target and Current Architectures

The configuration of a command center facility is driven by the missions and activities performed by the command center staff. Assigned missions determine what function-specific spaces need to be included in the command center. The CCDH, principally Volume 2, discusses the links between missions and work spaces in detail, and gives optimum configurations and specific guidance for each space. Because each fixed command center performs a unique mission and therefore requires a potentially unique set of work spaces, a target or current architecture common to all command centers has not been identified.

The CCDH provides detailed information about almost all furniture components and building components. As the range of possibilities in these areas is driven by technology, rather than military mission assignments, it is possible to document the current state of the art for each element and to project target capabilities for each.

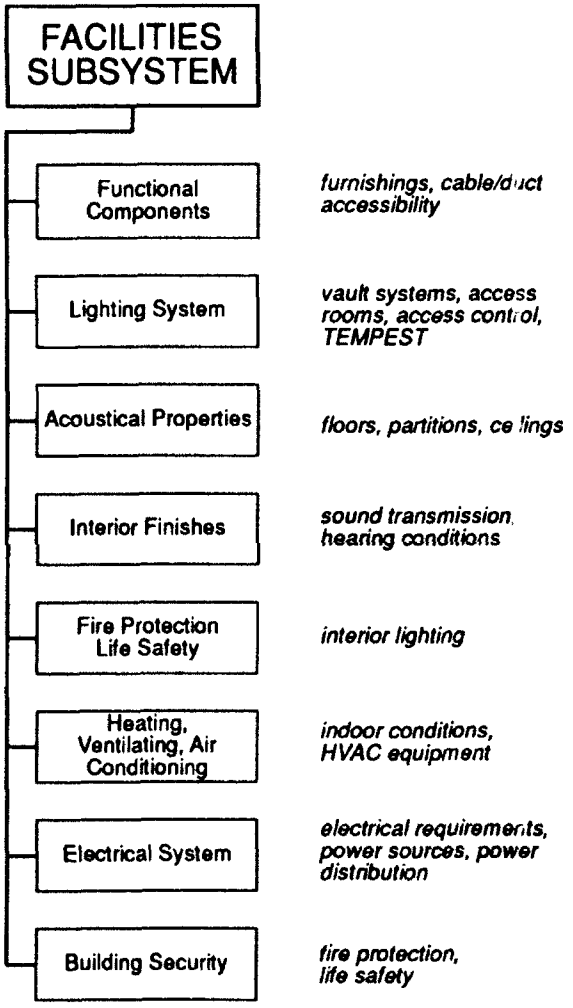


Figure 2-12. Facilities Subsystem Required Capabilities

PART 3. COMMUNICATIONS SUBSYSTEM

INTRODUCTION

The familiar acronym "C3" for command, control, and communications implies, justifiably, that communication is a primary component of U.S. defense policy and capability, a critical link in the command and control of forces and resources. From day-to-day operations such as monitoring the weather and supporting the logistical needs of military installations, to ultimate safeguards such as SIOP execution and nuclear-survivable communications programs, communication plays an important role in the defense environment.

This part of the CCDH discusses communications in the command center environment. The discussion begins by describing how communications as a whole is traditionally and most obviously been broken down: by the type of information – voice, video, or data – that is being conveyed. Because these categories are increasingly merging, a new concept of communications within the command center is evolving. It is foreseeable that one day voice, data, and video will be obsolete categories; all electronic communications will be transmitted in the same manner. For the moment, the command center system architecture breaks communications down by function, and the CCDH will follow suit. The latter portions of this chapter discuss the transmission of information between the command center and external sites (external communications), transmission of information within the command center (internal communications), and communications processing. However, because the traditional categories of voice, video, and data are still prevalent in technical circles, and because they are easily understood, this introduction and the subordinate levels of each section are structured around these terms. The intent is to keep the discussion of these complex issues simple to follow, and to make the reader aware of the changing nature of communications technology.

Introduction to Voice Communications

To be understandable by humans, voice communications must originate and terminate as analog signals. Analog signals, like human vocalizations, are continuous and infinitely variable, as opposed to digital signals, which are discrete "on or off" units. Traditionally, voice was also transmitted as an analog signal throughout the network. In the last ten years, more and more of the existing telephone equipment has been digitized to take advantage of digital services' cheaper transmission cost, higher fidelity, and additional user services. Almost all commercial and DoD local and long-distance telephone networks are digital. Many of the systems digitize the voice stream at the telephone; this provides end-to-end digital switching and transmission. Digital transmission enhances the capability for high-volume signal distribution with reduced noise. The digital signals can be completely regenerated and can be manipulated by error control and correction techniques.

Digitization has led to a blurring of the boundary between voice and data in telecommunications. Data services are being provided by what have historically been voice-only providers. Within this document, "voice communications" will denote voice services provided by telecommunications providers as well as private voice systems and networks.

Voice communications in a command center environment addresses the receipt, processing, switching, and transmittal of any voice-related communications. This includes both nonsecure Plain Old Telephone Service (POTS) and secure voice communications.

The command center will typically have telephone service either through a local switchboard, a telephone switch, or a private branch exchange (PBX). The telephone consoles are generally required to perform call intercepts, call forwarding, and conference calling. The consoles are typically dedicated for a nonsecure system (Black) and a secure system (Red), but in some command centers the separation of Red and Black is accomplished with independent consoles, each dedicated to its specific purpose.

Voice Communications Standards

Telecommunications must employ standards so that communication equipment can interface and interoperate. There are several standards bodies for voice communications. These include the Exchange Carriers Standards Association (ECSA), the Federal Communications Commission (FCC), the

International Telecommunication Union (ITU), the International Radio Consultative Committee (CCIR), and the International Telegraph and Telephone Consultative Committee (CCITT). Voice communications standards are listed in Figure 3-1.

Introduction to Video Communications

Video communication has historically consisted of wide-bandwidth analog transmission. Today, however, video is being digitized and, as with voice communication, the boundaries between voice and data are becoming less clear. "Video communications" will be defined in this document as those signals that begin and end as video, regardless of whether the signals are digitized in between. On the horizon, the advent of digital video carried on multimedia LANs opens up many new possibilities and potential challenges for video communications within a command center.

A command center must have the ability to transmit and receive external video communications, as well as to distribute video and computer-generated graphics information within the command center environment. Video communications plays an important role in providing a quick means to assess world events, monitor crisis situations, and conduct daily operations.

Video communication consists of video transmission and reception and internal distribution within a command center. Video transmission can either be done at full bandwidth or compressed bandwidth. By its nature, video transmission is bandwidth-intensive. Techniques have been developed to compress digital video signals so that they do not demand such inordinate bandwidth. However, the more effective and sophisticated the compression process, the more costly it is to implement electronically. Video teleconferencing is one application which has taken advantage of compressed video technology.

Video Communications Standards

Video communication standards allow video to be recorded, transmitted, and displayed in the same way by many vendors' products.

There are several standards bodies that govern video standards. These bodies include the International Telegraph and Telephone Consultative Committee (CCITT), the Electronic Industries Association (EIA), and the Federal Communications Commission (FCC).

Figure 3-2 describes the accepted and emerging standards governing video broadcasting and video teleconferencing that may be applicable for the current and target command center architectures.

Introduction to Data Communications

Data communication assets currently provide an increasing amount of the needed connectivity between the command center and the external world. The term "data communications" historically has referred to connectivity between electrical devices — that is, communication between mainframe computers, between a mainframe and a microcomputer, between a microcomputer and a peripheral device, etc. These devices communicate in machine language – encoded (digital) signals. In recent years, telecommunications carriers, the traditional voice carriers, have begun to offer data services. Voice and video information is being digitized, compressed, and transmitted over these telecommunications data lines. Thus, the once-clear distinctions between the three categories of voice, video, and data are now blurred and imprecise. Data communications is increasingly important as voice and video are digitized for transmission.

The term "data communications," as used in this document, refers to encoded communications that have been traditionally included under the "data" heading, as well as new data services provided by voice carriers. Systems that begin and end as voice or video, even though their signals may be digitized for transmission, are considered voice communications and video communications, respectively.

Data communication assets currently provide an increasing amount of the needed connectivity between the command center and the external world. Computer networks, both local-area and wide-area, rely on data communications and are providing an ever greater part of a command center's communications needs. Telecommunications providers are also responding to greater user need for digital communications by providing digital services.

Data communications networks generally consist of three components: architecture, network hardware, and protocols. A data communications architecture is a description of the functional arrangement and interconnection of equipment on the network. Architectures range from a simple con-

STANDARD	TITLE	DESCRIPTION	NOTES
CCITT V.27 (final, 1988)	4800 Bits Per Second Modem with Manual Equalizer Standardized for Use on Leased Telephone-Type Circuits	Specifies a Group III facsimile device	
FCC Rules and Regulations, Part 68	TBD	Provides standards for interconnecting to the public network	
RJ-11	TBD		

Figure 3-1. Voice Communication Standards

STANDARD	TOPIC	DESCRIPTION	NOTES
EIA RS-170	Television format	Describes commonly used NTSC standards	
CCITT H.261	Video Coding	Describes techniques in which video codecs decode bit stream information	Finished 11/90
CCITT H.230	Control and indication signals	Glossary of intercodec commands exchanged *during communications* sessions	Finished 11/90
CCITT H.320	Technical requirements for audio-visual systems	Narrow-bandwidth	Finished 11/90
CCITT G.711	64 Kbps audio	TBD	Adopted 1984
CCITT G.722	48/56/64 Kbps audio	TBD	Adopted 1986
CCITT AV.254	16 Kbps audio	TBD	6/92
TBD	Encryption	TBD	6/92
CCITT AV.231	Multipoint videoconferencing	TBD	6/92
TBD	Still-frame graphics coding	TBD	TBD

Figure 3-2. Video Communications Standards

puter-to-computer link to very complex arrangements involving communication processors, many computer workstations and electronic devices, protocol converters, encryption devices, and other communications equipment.

Network hardware comprises the communications medium and physical interfaces found in the network. The communications medium, for example, may be twisted pair wire, coaxial cable, optic fiber, or radio, microwave or satellite link. Physical interfaces are the connectors and interface units used to connect devices to the network.

Data communications protocols are collections of rules by which devices can communicate. Communications protocols vary in complexity, from single byte-by-byte transmission without error checking to complex rules for moving large amounts of data at high speed between multiple devices. The complexity of a communications protocol should depend on the complexity of the network and the requirements of the users.

Data Communications Standards

In order for devices to communicate with each other, they must be able to initiate contact, follow the same rules of communication, understand each other, and have a mechanism for error detection and correction. Communications standards are an attempt to define how devices will fulfill these requirements. These standards are put forth by a number of standards bodies, the most important of which are DoD, the American National Standards Institute (ANSI), Electronic Industries Association (EIA), Institute of Electrical and Electronics Engineers (IEEE), International Organization for Standardization (ISO), International Telegraph and Telephone Consultative Committee (CCITT), National Communications Systems (NCS), and National Institute of Standards and Technology (NIST). There is no such thing as a global or even national communications standard; however, because of cooperation and government and industry pressures, many of the standards bodies have coordinated efforts and share some standards. Some progress has also been made in international standards, such as CCITT X.25 and the Open Systems Interconnection (OSI) Reference Model.

A list of standards governing data communications appears in Figure 3-3, which spans the next 4 pages. Many of these standards, such as those making reference to LANs, cover functions in both the communications and information processing subsystems.

OSI Reference Model

The OSI reference model has the goal of allowing computers from multiple vendors to share information in a way that is transparent to users. Not all standards conform to the OSI, but because all standards have the same basic communications requirements, they can be thought of in terms of the OSI model. Therefore, understanding the OSI reference model is important to understanding and comparing many data communications standards. The model does not describe any particular system, but rather is a reference for designing communication systems.

The OSI model ensures the compatibility of devices by requiring compatibility at 7 layers. These layers are the Physical, Data Link, Network, Transport, Session, Presentation, and Application. The layers exchange information but are essentially independent of one another. The Physical layer describes mechanical and electrical characteristics, such as connector types and functions and speed of transmission. The Data Link layer specifies data format and performs data-level error detection and correction. The Data Link layer is sometimes divided into two sublayers: Logical Link Control (the upper sublayer) and Medium Access Control (the lower sublayer). The Network layer defines data addressing and routing. The Transport layer manages network level errors and data flow control. The Session layer performs network management, sends control messages, recovers from systems crashes, terminates sessions, verifies user passwords, etc. The Presentation layer provides for file transfer and network security and specifies how communications exchanges are to occur. Finally, the Applications layer supports end-user applications and provides communications services for specific computer applications. At the Applications layer are database management programs, electronic mail, and operating system and programming languages.

GOSIP 2.0 is a set of data communications standards based on the OSI reference model. GOSIP is required for use by federal government users. It replaces the older government standard, TCP/IP. The mandated use of GOSIP by the federal government will increase its prevalence in other markets and reduce the cost of GOSIP-compatible equipment. GOSIP works in conjunction with the POSIX operating system and the Applications Portability Profile (APP). Together, GOSIP, POSIX, and APP form a distributed processing standard.

The lowest four layers, the Physical, Data Link, Network, and Transport layers, are the most fully defined and have standards written to them. The most commonly used physical layer standard for connecting data terminal equipment (DTE) and data communications equipment (DCE) is defined as a

STANDARD	TITLE	DESCRIPTION	NOTES
ANSI/IEEE 802.1 (final, 1989)	Standard for Local Area Networks: Token Ring Access Method and Physical Layer Specifications method	Comprehensive standard for LANs. using token-passing ring access Will aid in the compatible interconnection of data processing	Same as IEEE 802.5 and similar to ISO 8802.5
ANSI/IEEE 802.2	Standard for Local Area Networks: Logical Link Control	Describes protocol of the logical link control sublayer of the data link layer of an OSI LAN protocol	Similar to ISO 8802.2 and forms a part of NIST FIPS PUB 107. Same as IEEE 802.2
ANSI/IEEE 802.4 (final, 1985)	IEEE Standard for Local Area Networks: Token-passing Bus Access Method and Physical Layer Specifications	Comprehensive standard for LANs using token-passing bus access method	Same as IEEE 802.4 and similar to ISO 8802-4.2
ANSI X3.139 (final, 1987)	FDDI Token Ring Media Access Control (MAC)	Protocol standard for high-performance multi-station networks.	Similar to ISO 9314-2
ANSI X3.148 (final, 1988)	FDDI - Physical Layer Protocol (PHY)	Physical interface standard for FDDI	Similar to ISO 9314-1
CCITT V.24 (final, 1988)	List of Definitions for Interchange Circuits Between Data Terminal Equipment and Data Circuit-Terminating Equipment	See EIA RS-232-D	
CCITT X.25 (final, 1988)	Interface Between Data Terminal Equipment (DTE) and Data-Circuit-Terminating Equipment (DCE) for Terminals Operating in the Packet Mode and Connected to Public Data Networks by Dedicated Circuits	Defines physical interface and protocol standards for packet-mode DTEs to access a packet data network	Similar to the combination of ISO 7776 and ISO 8208
EIA RS-232-D (final, 1987)	Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange	Defines physical interface standard, a 25-pin connector, for DTE and DCE (electronic or communications) equipment	Similar to CCITT V.24 and ISO 2110. Supersedes E/A RS-232-C

Figure 3-3. Data Communications Standards

STANDARD	TITLE	DESCRIPTION	NOTES
EIA RS-422-A (final, 1978)	Electrical Characteristics of Balanced Voltage Digital Interface Circuits	See MIL-STD-188-114A	
EIA RS-423-A (final, 1978)	Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits	See MIL-STD-188-114A	
EIA RS-449 (final, 1984)	General Purpose 37-pin position and 9-position Interface for Data Terminal Equipment and Data Circuit Terminal Equipment Employing Serial Binary Data Interchange	Defines physical interface standard, a 37-pin connector, for interconnecting DTE and DCE (electronic or communications) equipment	Similar to CCITT V.24, CCITT X.216, and ISO 4902
IEEE 802.2 (final, 1985)	Standard for Local Area Networks: Logical Link Control	See ANSI/IEEE 802.2	
IEEE 802.4 (final, 1985)	IEEE Standard for Local Area Networks: Token-Passing Bus Access Method and Physical Layer Specifications	See ANSI/IEEE 802.4	
IEEE 802.5 (final, 1989)	Standard for Local Area Networks: Token-Passing Bus Access Method and Physical Layer Specifications	See ANSI/IEEE 802.4	
IEEE 802.7 (draft, 1986)	Broadband Local Area Network Recommended Practices	Specifications for interface and low-level protocol for a local area network	Works in conjunction with IEEE 802.2
ISO 2110 (final, 1980)	Data Communication - 25-pin DTE/DCE Interface Connector and Pin Assignments	See EIA RS-232-D	
ISO 8802-3 (final, 1989)	Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications	Comprehensive standard for LANs using CSMA/CD as the access method. Encompasses several media types at rates of 1 Mbps to 20 Mbps, nominal at 10 Mbps	Supersedes IEEE 802.3

Figure 3-3. Data Communications Standards, continued

STANDARD	TITLE	DESCRIPTION	NOTES
MIL-STD-188-114A (final, 1984)	Electrical Characteristics of Digital Interface Circuits	Specifies physical interface standard for digital interface circuits, normally integrated onto IC chips	Similar to the combination of EIA RS-422-A and EIA RS-423-A or the combination of NCS FED-STD-1020-A and NCS FED-STD-1030
MIL-STD-1777 (final, 1983)	Internet Protocol	Protocol standard specifies the Internet Protocol (IP) that supports the interconnection of communication subnetworks	Together with MIL-STD-1778 forms forms the TCP/IP protocol
MIL-STD-1778 (final, 1983)	Transmission Control Protocol	Protocol Standard specifies a transport protocol for use in packet-switched communication networks	Together with MIL-STD 1777 forms the TCP/IP protocol
MIL-STD-1779 (final, 1989)	Interfaces for High Capacity C3 Local Area Networks	Specifies physical interfaces for high capacity command, control, and communication local area networks	
MIL-STD-1780 (final, 1984)	File Transfer Protocol	FTP is an application for TCP/IP that supports transfer of file data throughout a eterogeneous host computer network	
MIL-STD-1781 (final, 1984)	Simple Mail Transfer Protocol	SMTP is an application for TCP/IP that transfers electronic mail	
MIL-STD-1782 (final, 1984)	TELNET Protocol	An application for TCP/IP that is a terminal emulation protocol	
NCS FED-STD-1020-A	Telecommunications - Electrical Characteristics of Balanced Voltage Digital Interface Circuits	See MIL-STD-188-114A	
NCS FED-STS-1030	Telecommunications - Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits	See MIL-STD-188-114A	

Figure 3-3. Data Communications Standards, continued

STANDARD	TITLE	DESCRIPTION	NOTES
ANSI X3.66 (final, 1979)	Advanced Data Communications Control Procedures (ADCCP)	Protocol standard for synchronous computer links.	Same as NIST FIPS PUB 71. Same as HDLC except for Option 11. Similar to NCS FED-STD-1003
ISO 4335 (final, 1987)	High-Level Data Link Control Elements of Procedures	Defines operational modes and control procedures of HDLC Key standard for ISO HDLC protocol	Works with ISO 3309, ISO 7809 and ISO 8885 to form HDLC protocol
ISO 8885 (final, 1987)	High-Level Data Link Control Procedures-Genl Purpose XID Frame Info Field Content & Format	See ISO 4335	
ISO 7809 (final, 1984)	High-Level Data Link Control Procedures-Consolidation of Classes of Procedures	See ISO 4335	Replaces ISO 6159 and ISO 6256
ISO 3309 (final, 1984)	High-Level Data Link Control Procedures - Frame Structure	See ISO 4335	Similar to ANSI X3.66

Figure 3-3. Data Communications Standards, continued

25-pin EIA RS-232-D connector; related electrical characteristics are also specified as part of the standard. Other common interface standards are CCITT V.24, EIA RS-232-C, EIA RS-449, and MIL-STD-188. Interfaces complying with MIL-STD-188-144A can connect to RS-232-C devices through an interface connector.

Corresponding to OSI layer two are ISO 4335, ANSI X3.66, and IEEE 802.x. ISO 4335 is the key standard for the High-Level Data Link Control (HDLC) protocol. ANSI X3.66 is the aging ADCCP standard still used widely in military applications. The IEEE 802.x series of standards describes data link layer standards for LANs.

Standards that address the OSI model layer three include CCITT X.25 and MIL-STD-1777. CCITT X.25 defines protocols for packet-switched networks. MIL-STD-1777, the Internet Protocol (IP), is part of the widely used TCP/IP protocol.

Layer four is addressed by MIL-STD-1778 and a widely accepted European standard. MIL-STD-1778 is the Transmission Control Protocol, part of the TCP/IP protocol.

OSI reference model layers five and six are not yet well defined and do not have widely accepted standards yet. The types of functions described under layers five through seven apply to large heterogeneous networks that are only now being created. MIL-STD-1780, MIL-STD-1781, and MIL-STD-1782 belong to the OSI model layer seven.

There is not yet a networking standard for command centers, thus many standards may be in use within a command center. Standards that describe the characteristics of physical and electrical connectivity between two electronic devices are called interface standards. Protocol standards describe the rules that allow communications components to understand each other. The following list describes the standards governing communications interfaces and protocols that may be applicable for the current and target command center architectures.

EXTERNAL COMMUNICATIONS

External Voice Communications

Primary external voice communications resources include the Public Switched Network (PSN), private lines, and dedicated networks. A command center will use a combination of components from each of the three areas. Private branch exchanges (PBXs) and Centrex systems also provide external connectivity; however, because their most distinctive features pertain to internal call distribution and network management, they are described under the "internal voice communications" heading.

Public Switched Network

The PSN is the aggregate of commercial resources and telephone systems available for use by the general public. Here in the United States the PSN comprises local exchange carriers and long distance service providers. The services and cost structures are regulated by the federal government through the Federal Communications Committee (FCC). Overseas, the telephone service for the general public is usually provided by the government through the Postal Telegraph and Telephone (PTT). These systems are comprised of three elements: switching centers, transmission facilities, and signalling and control. The international switching and transmission systems are rapidly being digitized and providing new services and features such as call waiting, call forwarding, three party conference calling, and automatic number identification.

Signalling and control for the PSN is done either in band, that is within the voice signal's bit stream, or it is out-of-band. Most signaling for the long distance providers is accomplished out-of-band using Common Channel Signalling (CCS) System Number 7. Many of the Regional Bell Operating Companies (RBOCs) in the United States also provide CCS #7 within large metropolitan areas.

The PSN provides a host of services today that include Wide Area Telephone Service (WATS), 800 service, 900 service, and virtual network services. WATS is offered in several variations all based on reducing consumer cost due to volume calling and areas. Costs are based on monthly charges, installation charges, access line fees, and usage charges.

The 800 services are switched incoming voice grade services for voice and data transmissions. 800 services offer custom routing schemes based on areas and times of the day to route calls as specified by the users.

The 900 services are inbound calling services similar to the 800 services, with the exception that the caller is billed a set fee either per call or per connection charge and subsequent minutes spent on the service.

Virtual networks are a service provided by telecommunications carriers. Virtual networks are shared switched networks that are configured in such a way that they appear to be a dedicated network for the user. Virtual networks can provide users with direct control over call routing and configuration of the virtual network. Virtual networks can accommodate voice-only or voice and data. The PSN has some drawbacks, however, the most notable of which is that the user does not have complete control of network management, security precautions, and cost efficiency. In some cases, dedicated networks or private line networks can help control costs and fulfill operational requirements not satisfied by the PSN.

Private Lines

Private line service involves the leasing of public telecommunications service for private dedicated use. Users can lease point-to-point services for their exclusive use from the commercial companies. Private lines have the advantage that they are always available, but they are more expensive to operate since costs are not shared with other users.

Dedicated Networks

Dedicated networks are those assets that are built and operated exclusively for a single user or group of users. The network itself may use combinations of private line service and commercial service as well as privately owned assets such as microwave, radio and satellite connections and digital switches. Examples of dedicated networks include the Red Switch Network, Defense Switched Network, Defense Commercial Telecommunications Network, and the Federal Telecommunications System (FTS) 2000. Dedicated networks can improve cost efficiency for a command center and they ensure direct control and maintenance of the network to support critical functions.

External Video Communications

External video communications consists of the reception and transmission of broadcast television and is an important capability for the command center. Broadcast television, both commercial and private military, is a valuable source of information for command center decision-makers. Video teleconferencing is a newer, but no less powerful tool for the command center. Video teleconferencing can be used for crisis management, project/program working group meetings, briefings, informal information exchange, training, and many other uses. All commercial broadcast television in the U.S. is in National Television System Committee (NTSC) format. Most military broadcast television is also in NTSC format. Normally intercepted by a facility antenna or satellite receiver dish, a transmitted RF signal is demodulated into baseband video with audio and subsequently distributed internally within the command center. At present this baseband video information is standard NTSC analog broadcast video.

Throughout the world there are different standards used to create, broadcast, and display video television signals. These standards are unique to various countries around the world. There are three important global standards. The United States, Japan, Canada, and Mexico for example, adhere to the NTSC television broadcast standard. Other countries have chosen different systems; the UK and Germany use the Phase Alternation Line (PAL) standard; France and the USSR use the Sequential Couleur avec Memoire (sequential color with memory) or SECAM broadcast standard. The differences between the three standards are mainly in the encoding and decoding of the transmitted signal. NTSC video uses 525 scanning lines per video frame, which is displayed at 30 frames/second. PAL and SECAM video signals are 625 scan lines displayed at 25 frames/second. If broadcast television feeds are received by command centers overseas in which the PAL and SECAM international broadcast standards are used, they must be converted to NTSC at the front end using a device called a standards converter (see Communications Processing).

Video Teleconferencing

Video teleconferencing (VTC) can be used for crisis management, project/program working group meetings, briefings, informal information exchange, training and many other uses. VTC provides remote access to information sources, in the same way as a telephone, computer link, or a TV broadcast. VTC is unique in that it provides interactive, multisensoral communication over distance. It establishes an environment which combines visual and aural information, thereby offering an experience similar to a face-to-face meeting.

A VTC element comprises the collective studio facilities, equipment, and arrangements required at an individual location to support teleconferencing requirements with remote parties. VTC transmission is generally performed over data communications lines. Because it involves display and facility configuration as well as communication, video teleconferencing is a complex technology that spans the conceptual boundaries between subsystems and categories.

Although VTC technology has been available for a number of years, the potential for cost-effective VTC stems from two major technology events: the competitive pricing of digital signal transmission media, and the refinement of digital video compression equipment and conferencing techniques. Digital transmission services became more available and affordable in the 1980s. There are currently several "standard" digital data transmission rates for VTCs in Europe, the Far East, and the United States, ranging from 2.048 Mbps down to 56 kbps. All can be used for interactive VTC with the support of appropriate video compression equipment. A more complete discussion of digital transmission is included in Part 3, under the heading Data Communications.

Video compression and conferencing techniques have become more sophisticated. Better compression algorithms maintain picture quality at lower transmission rates. The advent of multipoint or "N-way" conferencing now provides the ability to hold videoconferences between three or more sites simultaneously.

Establishing a successful video teleconferencing capability at a command center requires consideration of the environment in which the local aspect of a conference will occur, audio and video acquisition and output devices, conference control, and switching, as well as video compression and transmission. This text addresses only the external communications aspect of the topic.

VTC Audio Communication

There are three basic techniques employed in the audio portion of teleconferencing systems: Half-duplex, semi-duplex, and full-duplex. Half-duplex systems provide a transmission path only for the site that "speaks" first, thus "capturing" the audio system. The distant site audio is muted until the audio from the first site ceases. When a capture time lag is long, these systems can be difficult to use. Semi-duplex systems are half-duplex systems employing extremely fast switching and can approach the naturalness of full duplex

systems. They also avoid the problem of potential audio feedback among sites, because no round trip audio path is available. However, the conversation can be somewhat choppy and room noise can cause premature switching, suddenly cutting off the far end speaker. Full-duplex systems permit natural, two-way conversation, but unless echo is controlled, such open audio systems can cause severe acoustic problems. Because both the send and receive circuits of the two systems are open at all times, sound that originates at one location can be reflected back via the other path, causing acoustic feedback or breaking up the audio in other ways. In full-duplex audio systems, echo control is of paramount importance.

Video Compression

NTSC signals are bandwidth-intensive, requiring 5 MHz (analog) or 90 Mbps (digital) for transmission. Add the need for two-way communication with video, audio, graphics, control, and data, and the bandwidth requirement for video teleconferencing becomes very large. Digital data compression is used to reduce transmission bandwidth requirements.

A video codec is used to perform the video compression. Codecs compress video signals by removing a certain portion of the data they carry. It is possible to do this without noticeably degrading the displayed image because almost all video contains a significant amount of redundant information. Also, the human eye is very tolerant to "missing" information and optical illusions; a human viewer will not perceive that anything is lacking from a compressed image. Codecs are described further under the Video Communications Processing heading.

In NTSC, a frame of video is generated every 1/30th second. Changes from frame to frame give the illusion of movement; usually, however, only parts of the picture change. Other parts are simply redundant to those in the preceding frame. A frame difference generator in the codec compares successive frames and provides only the difference information (with the predecessor frame) to a coder. The coder further compresses the information. This information is then multiplexed with audio, control, and user data prior to encryption and transmission. The process is reversed for incoming signals. In essence, a codec uses intense hardware and software processing (video compression) at each end of a VTC link to reduce the amount of information which must be sent over the communications link.

Many different approaches to video compression have evolved. To date, virtually all codec manufacturers use different algorithms and software. Codecs from different manufacturers, even if operated at the same data rate, are unable to communicate with each other. In order to allow for interoperation, CCITT has adopted the H.261 standard that applies across the spectrum of bandwidths from 56 Kbps to 2.048 Mbps. The CCITT H.261, also known as Px64 ("P times 64"), is based on channel rate multiples of 64 kbps and standardizes the way video codecs decode signals on the VTC network. Equipment that adheres to H.261 will be able to interoperate; however, manufacturers will still retain wide latitude in how the signals are encoded for transmission. Because the CCITT is not expected to set standards for preprocessing, encoding, and post-processing of a video feed, picture quality will still vary from one codec manufacturer to another.

VTC Transmission

Video codecs use data communications lines to transmit the video information. The most important consideration for VTC transmission is the available bandwidth or data rate.

At present, VTC codecs have migrated to two data rates in the U.S.: 1.544 Mbps (T-1 or DS1) and 56 kbps digital data networks. Much interest has also occurred in "sub T-1" codecs operating at rates as low as 384 kbps. (T-1 and fractional T-1 services are discussed in the next section, External Data Communications.) Generally, the lower the transmission bandwidth, the lower the quality of the video picture.

In addition to procuring transmission services from a telecommunications carrier, some DoD users will be able to utilize the Defense Telecommunications Network (DTCN), which provides leased communication services including multipoint VTC in the continental United States. Multipoint VTC services will operate at 1.544 Mbps and consist of transmission, switching, control, and audio bridging. DTCN also provides dedicated point-to-point services at 56 kbps.

External Data Communications

External data communications services are provided by a number of military and commercial telecommunications providers. The services available include Digital Data Service (DDS), T-1, T-3, and Fractional T-1. Digital Data Service is a 56 Kbps or 64 Kbps data line available from telecommunications providers.

The term T-1 designates a digital transmission channel over any medium that supports a 1.544 Mbps data rate. A T-1 supports combinations of 24 channels of voice or data operating at 64 Kbps. The channels are combined by using a channel bank or T-1 multiplexer.

T-3 facilities operate at 44.736 Mbps and represent 28 T-1s or 672 individual 64 Kbps channels. T-3 systems operate over fiber optic lines or microwave systems. T-3 is not only fast but cost efficient for large volume users. T-3 multiplexers are available for users to consolidate voice traffic with data and video teleconferencing.

Fractional T-1 involves splitting off and leasing segments of a T-1 line. It was designed for users with requirements above the 56 Kbps rate but below the needs and costs of a full T-1. The service is split in increments of 64 Kbps with rates of 128 Kbps (2 channels), 256 Kbps (4 channels), 384 Kbps (6 channels), and 768 Kbps (12 channels). Because it is offered in modular channel increments, fractional T-1 is an attractive alternative for low-to-medium volume users; they can lease just the service they require, and add additional channels in small increments when needed. Controversy exists in the telecommunications industry over how long fractional T-1 will remain the state of the art, as the next generation of technology is anticipated to be offered soon. The new demand is for vendors to offer fractional T-3 service as the need for data communications continues to grow. In any event, use of fractional T-1 is widespread and it will remain a viable technology for the foreseeable future.

Another capability of modern telecommunications is the Integrated Services Digital Network (ISDN). ISDN is an ambitious network service architecture that will support voice, video, data, teletext, and image services through a standard interface over the telephone system. Currently, users have telephone service, data services, teletype services, and video distribution all coming from separate systems and vendors to their facility. The ISDN is a means to integrate these services at the data network and the user level. Several vendors offer various levels of ISDN service primarily through the Basic Rate Interface (BRI) and the Primary Rate Interface (PRI). The BRI is a single data channel operating at 16 Kbps used along with two voice/data channels operating at 64 Kbps. This is collectively 144 Kbps operating on standard twisted pair wiring. The PRI is 23 channels operating at 64 Kbps along with one operating at 16 Kbps. The PRI at 1.536 Mbps can thus operate over a standard T-1 channel (T-1 is described under External Communications Systems.) In the future, ISDN will offer other services such as electronic-mail, video text, and telemetry. ISDN will also offer high bandwidth services and applications through the Broadband ISDN (BISDN) and H channels at speeds of up to 135 Mbps. The comprehensive BISDN specification will be completed in 1992 for inclusion in a CCITT Recommendation.

In addition to the various data communications systems and services in existence, some data communications hardware deserves mention. Facsimile devices have become widespread in the command center as well as in government and industry. Facsimile units operate over standard telephone lines to transmit text, graphics, images, and charts. The facsimile unit scans and digitizes documents for transmission over standard telephone lines. Most devices provide automatic document feeding, activity reports, preset dialing, and multipoint broadcasting. A Group III facsimile modem is compliant with CCITT recommendation V.27. At a data rate of 4800 bps, it can transmit a page in 40 seconds. The newer Group IV facsimiles require DDS circuits and operate at a rate of 64 Kbps. A Group IV facsimile device can transmit a single page in less than five seconds. Most facsimile units offer various interface options, such as RJ-11 connection to a telephone line, or RS-232 or RS-449 data interfaces to computer terminals or STU-III handsets.

Modulator/demodulator devices, universally known as modems, are common data communications instruments. Modems allow computer data to be transmitted across phone lines by converting the data to sound. They perform handshaking functions to ensure accurate transmission. Most modems operate at baud rates of 1200 or 2400 bps; high speed modems can operate at up to 19,200 baud. Modems are manufactured by Hayes Microcomputer Products, Codex Corp., Motorola, and others.

INTERNAL COMMUNICATIONS

Internal Voice Communications

Internal voice communications resources provide for communication within a command center as well as interfaces to external voice communication systems. A command center will typically have telephone service either through a local switchboard, telephone switch, or a private branch exchange (PBX). Telephone consoles usually must offer the capability to perform call intercepts, call forwarding, and conference calling, to enable, for example, EA

personnel to manage alert notifications or a group of decision makers to converse all at once. Separate consoles are typically dedicated for a nonsecure system (Black) and a secure system (Red). Some of these systems also offer direct inward and outward dialing, which allocates an extension to each telephone set so that users can receive calls directly.

Internal voice communications systems include PBX systems, central exchange (Centrex) systems, and electronic key systems. PBX and Centrex are the two most popular choices for internal voice distribution. Figure 3-4 identifies a number of possible selection criteria for all three types of systems. These systems are described under the "internal communications" heading because they offer substantial capability for communications within a site and local control of the system; however, because such exchanges connect the facilities that own them to the outside world, they can also be considered external communications resources.

PBX Systems

The PBX of today is a digital switching system providing connectivity between the users and to outside networks. The physical interface between the station set or telephone and the switch is called a port. Some manufacturers allow 2, 4, or 8 telephones to connect to a single port, thereby increasing the capacity of the PBX. The access interfaces between the switch and the various external networks are generally called trunk interfaces. These trunk interfaces provide access to the various networks such as the Public Switched Network (PSN) or a government system such as FTS 2000. The PBX is controlled by a computer processor, which establishes the call set-up routines, allocates resources, collects record traffic, provides for conferences, and allows testing and maintenance functions. The PBX is primarily intended for internal calling and as a central interface for external calling. The PBX can consolidate the limited number of outgoing trunks into a shared arrangement. The users would have to use an access code (usually the digit 9) to initiate a dial-tone on an available commercial access trunk to the PSN.

Leading PBX vendors include NEC, Northern Telecom, Rolm, and AT&T. The ports for the new digital PBXs generally use proprietary interfaces conforming to individual vendor specifications for signaling, transmission, and control. The exception to this is the standard Bell 2500 set which has existed for a long time. The 2500 sets are the telephones typically found in homes. PBX vendors usually provide station cards to interface their proprietary ports to the 2500-type sets; however, it is generally more cost-effective for an organization to purchase all new telephones. The newer instruments on

Type of system: ☐ Key ☐ PBX ☐ Centrex

Transmission type: ☐ Analog ☐ Digital

Maximum number of outside lines or trunks _____

Maximum number of ports or stations _____

Allows: ☐ Voice ☐ Data ☐ Both

☐ Blocking ☐ Nonblocking

Capable of supporting ISDN functions? ☐ Yes ☐ No

Allows T-1 networking? ☐ Yes ☐ No

Supports remote maintenance? ☐ Yes ☐ No

Performs automatic call distribution? ☐ Yes ☐ No

Preforms least-cost routing? ☐ Yes ☐ No

Performs call accounting? ☐ Yes ☐ No

Supports message waiting? ☐ Yes ☐ No

Allows LAN interfaces? ☐ Yes ☐ No

Is upgradable? ☐ Yes ☐ No

Adapted from "The Office," pp. 41–43, September 1991

Figure 3-4. Telephone System Selection Criteria

the market provide single button features for call transfers, call holding, abbreviated dialing, and call pick-ups. These electronic sets also usually require more than one pair of wires to the station in order to carry special control signals and the power for the feature indicator lights.

CENTREX

In a CENTREX environment, the telephone switching and PBX functions are performed at the telephone company's central office (CO) rather than in an on-site system. CENTREX offers direct outward dialing (DOD) and direct inward dialing (DID) as well as station-to-station dialing, automatic identified outward dialing (AIOD), and attendant console features. CENTREX service is arranged for groups of lines so that the customer can have four- and five-digit dialing. Digital CENTREX services also include protocol conversions for data transfers, modem pooling, station message detail recording (SMDR), voice mail, Automatic Route Selection (ARS), and uniform call distribution (UCD). CENTREX also offers customer-controlled reconfiguration. Customers can dial into their central office's database and instantly change their feature mix. Like PBX equipment, CENTREX station equipment can provide many features through single button access. CENTREX service can also support a central attendant console, which can be bought from CENTREX equipment vendors. These systems can handle multiple lines and combine the features with a computer.

Key Systems

Key systems have been in use for over 70 years. The most widely used were the Bell 1A and 2A key telephone systems. The term "key" is a carry-over from the early days of telegraph and telephony, when the mechanical arrangements used to close a circuit were called keys, as in the old telegraph keys. Each button on a key telephone was designed to close an electrical contact. Key systems today provide the traditional functions of accessing multiple telephone lines from a single instrument as well as placing callers on hold while initiating another call. Electromechanical versions typically have a key service unit (KSU), a key telephone unit (KTU), a power supply, and terminal equipment. The KSU housed the switching electronics from the trunks to the individual stations. The KTUs, mounted within the KSU, perform the line connections, intercom functions, paging, and station connections. There are separate KTUs for line connections, station lines, and intercom circuits. The station equipment used with the system is generally six- or ten-button desk key telephones. Electronic key systems use integrated circuits to build the KTU instead of the large relays and discrete electrical components used in the electromechanical KTUs. The electronic system uses specialized circuits that latch a selected line. This simplified design, along with the use of microprocessor controlled logic for controlling functions, greatly simplifies the wiring requirements. Usually only two or three pairs of wires can carry the control and voice data. Electronic systems also offer more advanced features, such as speaker phones, SMDR, least-cost routing, direct inward system access, and remote maintenance and diagnostics.

Internal Video Communications

Video information helps command center personnel make informed decisions, confirm status, and communicate with other decision makers. To accommodate this, video signals must be routed to various destinations within a command center. Broadcast television and video teleconferencing signals are provided from external video communications. At present, this baseband video information is standard NTSC analog broadcast video. Internal distribution of the signals as a source or video "feed" is processed within the communication subsystem. Destinations for this video "feed" are the information processing subsystem and the briefing and display subsystem. In practical terms, internal video distribution allows video information to be viewed from many locations within the command center. Secure switching arrangements can ensure that classified video is displayed only on cleared monitors.

Internal cabling for signal distribution has traditionally been copper wire, but fiber optic cabling is becoming widely accepted. Copper wire will continue to be cost effective for short cabling runs and for terminating with hardware such as video distribution and switching equipment. Fiber optic cable eliminates electromagnetic noise interference and ground loop problems, and it increases signal bandwidth handling.

Video signal quality can degrade for a number of reasons when sent over a distance. Degradation due to copper cable runs, light attenuation, and electromagnetic interference, as well as improper termination of source video, all contribute to video image quality loss. Video processing is necessary to stabilize and restore video signals.

Internal Data Communications

According to the command center system architecture, internal data communications consists of a LAN linking the various communications subsystem components. This LAN will also interface with the FDDI backbone network, which is part of the IPS subsystem. LANs are described in detail in Part 4, under Local Area Communications.

COMMUNICATIONS PROCESSING

Voice Communications Processing

Voice processing systems include automatic call processing systems, voice mail systems, and interactive voice response systems. Each of these is provided by on-site equipment at the command center. Automatic call processing refers to systems that use computers to completely process and handle a call using speech recognition and computer-generated voice announcements. Voice mail refers to systems used to record and store voice messages that can be retrieved at a later time or from a remote location. Voice messages can be multibroadcast for news announcements, recalls, and notifications. Interactive voice response refers to systems that retrieve information on databases through interactive queries using the telephone keypad. These are widely employed in the commercial arena for information networks, credit balance checks, and consumer purchasing.

Video Communications Processing

Video communications processing is performed by an array of equipment, including switching systems, video processing amplifiers, video and audio distribution amplifiers, video encoders/decoders, scan converters, standards converters, video signal generators, line doublers, and waveform monitors and vectorscopes. Each type of component is discussed below.

Switching Systems for Routing and Distribution

Video, audio, and data signals are required to be routed to various destinations within a command center. Signal routing switchers (routers) provide a means by which these signals can be efficiently sent to, and controlled by, various locations within the facility. Because these routers become a central and somewhat permanent part of a command center facility, their selection should be carefully undertaken. To effectively route video, audio, and computer graphic information, a thorough needs analysis is required for designing or upgrading such a system. The types of signals (NTSC video, RGB video, hi-resolution computer graphics, audio), size of the router in terms of inputs and outputs, and means of controlling the switcher are vital aspects to successful system design. The basic functions of a switcher for audiovisual applications are to:

- Permit the routing of any video source to any display device
- Route any input to any output (full matrix switching)
- Handle component (RGB) and composite (NTSC) video signals and audio (as required)
- Distribute high-resolution computer graphic imagery without image degradation.

A number of basic terms that are associated with switching systems are key to understanding the following paragraphs. These terms are:

- **Sources**, devices which produce (output) a signal such as audio or video.
- **Destinations**, devices which accept (input) a signal such as audio or video.
- **Crosspoints**, circuitry which acts as the physical switch that permits signal information to pass through when "turned on" or "activated."
- **Switching Bus**, crosspoint groups that have a common output.
- **Matrix**, an array of crosspoints (usually thought of from a design point of view) with horizontal and vertical axes representing inputs in one direction and outputs along another. Also a term used when referring to a complete switching system, as in a matrix switcher.
- **Levels**, the number of discrete signal types that pass through the router. For example, an RGB video signal consists of three levels, one level of circuitry associated with each color, red, green, blue. Stereo audio, as another example, requires two levels for left and right signal information.

Generally configured in a rackmount enclosure, a router consists of a user-defined quantity of crosspoint plug-in circuit cards, power supplies for these circuit cards, and a quantity of specific types of controlling panels (controllers). Thought of as an *X by Y* grid of *inputs vs. outputs*, typical building block sizes for routers are 8x8 and 10x10 for each separate type of signal (level). Router configurations can grow as requirements evolve, influenced by issues such as modularity, physical equipment enclosure space, and system throughput frequency response. Routing system matrices can be very large; 200x200x5 levels (RGB video and stereo audio) exist in the broadcast television industry. System expansion for a router can be simple and straightforward if properly planned; adding additional levels of sources and destinations is done by adding additional plug-in boards to the system enclosure. Figure 3-5 shows a basic switcher block diagram.

Knowledge of signal bandwidth requirements for a router are paramount and will narrow the field of selection when budgeting for a switching system. The increased use of computer-generated imagery for BDS applications requires that image integrity be maintained when an image is routed to various destinations. Sufficient bandwidth specifications are therefore essential to properly handle this type of hi-resolution visual information. Tests have been conducted to determine the minimum acceptable bandwidth necessary for a switcher system to accommodate hi-resolution computer images. A minimum acceptable bandwidth specification of 70MHz will, for example, allow graphics created on a Sun workstation to pass through a routing switch without degradation. A number of product manufacturers have responded by offering 100MHz wideband switchers to properly handle high-resolution graphics currently generated within a command center on machines such as Sun and Hewlett-Packard workstations. These wideband switching systems can be very expensive depending upon size requirements. If NTSC or RGB video information is all that is required to be switched and distributed, a low bandwidth switcher such as a 30 MHz system may be sufficient. It is critical to understand the signal types *currently* in use, as well as to assess and define *potential* signal handling requirements when planning a routing system. Budgetary concerns are heavily influenced by system bandwidth in addition to matrix size requirements; upgrading a system that was not properly specified initially can be very costly.

Specifying matrix size and signal bandwidth requirements are both important in their own right; however, identifying operator control is crucial and should not be overlooked when designing or upgrading a system.

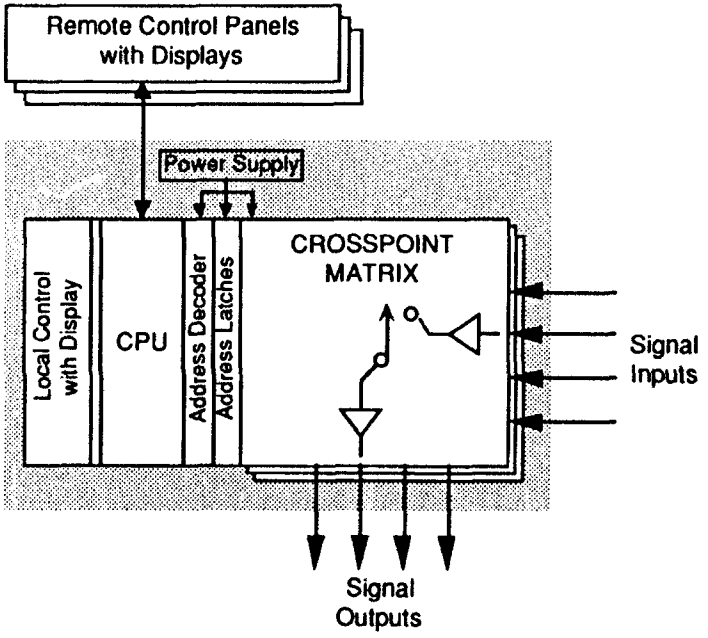


Figure 3-5. Basic Switcher Block Diagram

Controlling equipment translates a user's commands to establish or break a switch within the matrix, and also displays the status of the matrix. Control of the router can be provided in three ways:

- Centralized
- Distributed
- Local or remote.

Centralized control is most effectively carried out via microprocessor control from a PC. Under the direction of specialized software, a PC performs the duty of monitoring signal flow and performing configuration changes electronically within the switcher itself. This approach is very efficient and this application continues to grow in popularity. The ability to rapidly re-configure and distribute signals, as well as store and recall these different configurations, merits consideration of PC control as a means of managing router system configuration and control. Another major asset of PC master control is the ability to "remember" an entire matrix configuration in the event of an unforeseen power outage.

Distributed control basically provides control to various locations. Operationally, a command center requires efficient switching of different video signals to specific locations. Under distributed control, the end user receives and displays audiovisual information specific to his or her needs. CNN television routed to specific TV monitors scattered throughout the building, a mapping display constantly "running" in a conference room, and a radio program playing background music in a cafeteria are all examples of distributed switching. These signals might be pre-assigned prior to distribution, and would be routed to, but not necessarily controlled from, specific locations within the command center.

Local or remote control empowers end-users with switcher control capabilities. Multiple control panels can be placed in locations throughout the command center to allow separate groups to control switching of specific crosspoints they may need. Types of remote control include single-bus, multi-bus, and X-Y. Using the master PC control described above, groups of sources and destinations can be programmed for specific local control panels. These local panels in turn gain control of a specific output (single-bus), multiple output destinations (multi-bus), or control of the entire matrix (X-Y). These control configurations are pictured in Figure 3-6. Crosspoints assigned to specific panels can lock out or restrict access to certain audiovisual information. This authorizes a level of security by assigning pertinent information to select groups "for their eyes only." Panels can be configured as table-top or

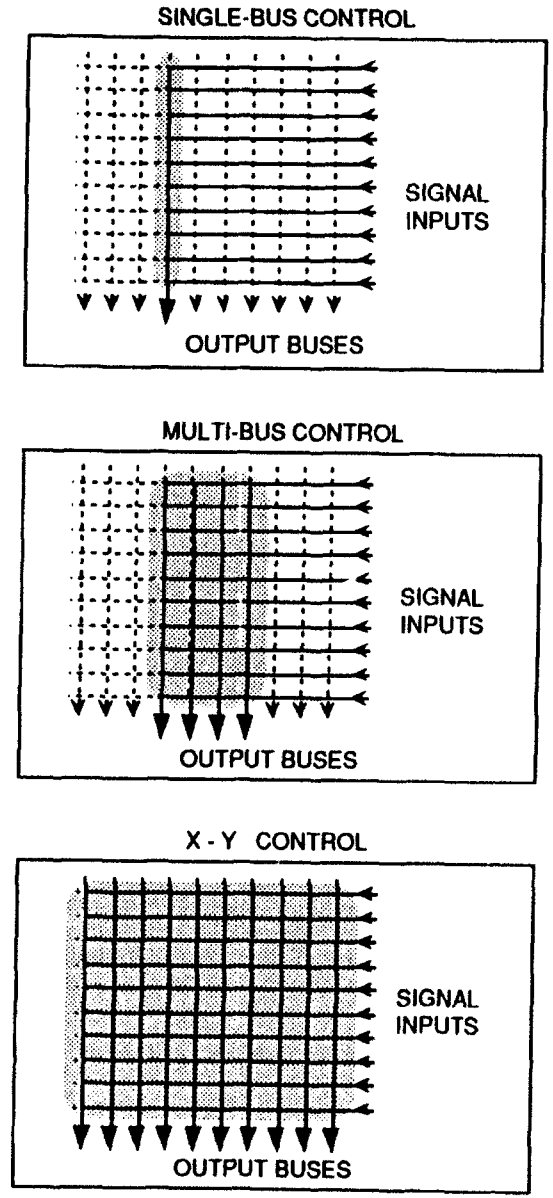


Figure 3-6. Control Configurations

rackmount, for example, and are generally push-button, rotary dial, and even thumbwheel designs. Alpha-numeric status displays provide a means of identifying what particular information a user is currently accessing. Additional capabilities of remote control include modem dial-up from an offsite location, in which dialog between the matrix switcher and the controller device can occur.

Control capabilities are generally treated merely as options by equipment manufacturers, but this should not undermine their importance to command center designers. They accelerate reconfiguration of sources and destinations and should be carefully selected to address a command center's specific needs. Currently, it is not possible to mix and match controllers made by different manufacturers within a system. Controllers will be another important budgetary consideration when designing or upgrading existing switching systems. An understanding of controllers from a technical point of view, coupled with defined end-user requirements, will streamline system design and subsequent product selection.

Video Processing Amplifiers

Video processing amplifiers, often referred to as "proc amps," allow video source material to be "conditioned" to make up for signal loss due to transmission. A proc amp contains features similar to those found on a television set, such as chroma gain (color adjustment), video gain (brightness), set up (contrast), and burst phase (tint). Proc amps also recondition video timing (horizontal and vertical synchronization) information to stabilize incoming source video. A video processing amplifier is a valuable tool for maintaining proper video signal integrity.

Video and Audio Distribution Amplifiers

Video and audio distribution amplifiers (DAs) are necessary for a number of reasons. One reason is that video signal quality degrades over distance due to high frequency losses associated with long-distance transmission, copper cable runs, light attenuation, and improper cable termination. It is also necessary to properly amplify single video signal sources that are to be sent to multiple destinations. To accomplish this "video splitting," DAs are used.

DAs take a single input signal, amplify it, and multiply (fan out) the signal. The output signals are clones of the original input signal, allowing a single video and/or audio source to be split into multiple outputs for signal distribution or routing. Configurations are generally specified as one input-four outputs, one input-eight outputs, etc., and should allow for small adjustments in the output signal level. If these devices are daisy-chained together, the number of outputs available from a single input can grow according to individual needs.

Distribution amplifiers generally come in a rack-mount enclosure. A plug-in card/cage configuration offers the flexibility for future expansion.

Video Encoders and Decoders

Standard NTSC color video signals are generally processed as either composite video or component video. Composite color video contains all of the color as well as timing (synchronizing) signal information combined as one signal. More specifically, composite color video consists of blanking, field and line synchronizing signals, color synchronizing signals, and chrominance and luminance picture information. These "ingredients," when combined as a single package, form a composite video signal. Commercial video equipment, such as VCRs and color video monitors, is designed to accept composite signals.

There are inherent advantages, such as improved picture quality, that can be achieved if the color information portion of this signal is broken down and separately processed. A video decoder performs the task of separating the red, green, and blue color information from a composite input signal and provides the separate RGB signals to output to another device.

Conversely, to convert a component video plus synchronization (that is, separate red, green, and blue, plus synchronization, known as RGB+S) signal to a composite video signal, a video encoder device is used. For example, an NTSC encoder will allow a non-RGB color monitor to display RGB information. The signal quality will not be as good as if the RGB signal integrity had been maintained from source to destination.

To properly display or further process analog video signal information, devices handle the incoming NTSC video signal in either composite or component form. Video encoders and decoders can be thought of as signal "converters" or "adapters," similar in purpose to hardware connector adapters that are used to provide a proper interface between cabling and equipment. Just as hardware requires a specific physical connector or adapter to properly pass a signal to another device, encoders and decoders allow an incoming video signal to "fit" or interface properly for display or recording purposes.

Scan Converters

Scan converters convert high-resolution computer graphics into a video signal that conforms to the RS-170 (NTSC) video standard. While a number of products have claimed the capability to convert graphics signals to "RS-170 like" signals, these signals in the past have suffered from many of the following shortcomings:

- They could not be recorded on a videotape recorder and, in general, could not be processed by standard video studio equipment.
- They offered no flexibility of display. The picture could not be positioned on the screen.
- They offered no flexibility to adjust spatial resolution or mitigate flicker.
- Modifications to the initiating computer were required.

The current generation of scan converters is addressing these limitations through the use of more powerful hardware and improved data compression algorithms. Zoom functions, aspect ratio adjustment, anti-aliasing to reduce flicker, and even frame grabbing for compositing of images are available.

An analysis of the types of computer data to be used (graphical or textual) is imperative when designing a system that includes this type of equipment. It is critical that a converter be capable of converting the scan rate and resolution of the computer data it is sent. The capabilities of any scan converter should include:

- Digital capture of the frame data, and reformatting to conform exactly to the RS-170 standard
- Locking of the graphics signal to an externally supplied studio synchronizing pulse ("genlock")
- A means to position the picture within a screen and optionally create a border
- Allowance for variations in spatial resolution through the replication of pixel, line, and field data (to improve clarity, reduce flicker, etc.)
- Direct interface to the computer graphic digital output.

Price is a distinguishing characteristic between converters, reflecting a wide range in the quality of the products. The Mediator from Videologic, the YEM - CVS-980, the Lyon Lamb RTC, and products from Folsom Research are examples of computer-to-video scan converting equipment.

Standards Converters

Although the lack of unified global standards can complicate the exchange of video programs (videotapes for example), a digital standards converter allows any video standard format to be converted digitally, processed and reformatted, and output as another broadcast standard format in real-time. The requirement for standards conversion is singularly dependent upon a command center's location around the world. If a command center such as EUCOM in Germany has the requirement to receive "local" broadcast information, a conversion at the head-end feed from the antenna from PAL format to NTSC format must take place for the video to be distributed to an NTSC video switch or display device.

All standards conversion equipment performs a large amount of "number crunching" to accomplish its basic purpose; products with varying levels of complexity offer a range of additional capabilities. High-end units incorporate features such as four-field processing, motion prediction, timebase correction, and freeze-frame options. Equipment pricing varies widely, ranging from around $10,000 to nearly $200,000, with cost-effective units averaging approximately $40,000. Manufacturers of standards converters include Snell and Wilcox, CEL Electronics, I.Den Videotronics, and OKI Electric/Saeco International.

Video Signal Generators

The signal generator, when combined with a waveform monitor and a vectorscope, forms a baseline video signal monitoring and test station for a command center. This device provides a variety of calibrated video test signals that can be used to verify the performance of video equipment, and is valuable as a genlock source by which video signals can be properly transmitted and displayed.

The most common test signal available is the color-bar signal. Color bars provide a calibrated reference signal allowing for proper color adjustment for video displays. The color-bar signal is also used to check overall system gain, chrominance/luminance gain, setup and sync level, and noise. A second test signal called multiburst allows frequency response to be checked.

The trend in video signal generators utilizes digital test signals that are calibrated to NTSC RS-170 standards. The TSG-170A from Tektronix, for example, provides numerous test pattern signals as well as a built-in sync generator for master video equipment synchronization; an optional alphanumeric character ID that can be used to identify video signal feeds, videotapes etc.; optional audio tone output for measuring audio signal path continuity; and level calibration. Further developments will result in more capabilities being made available, reductions in device size, and increased portability.

Line Doublers

A line doubler gives the illusion of improved picture quality while not actually increasing the information in an image. This device doubles the number of lines in an image by tracing each line twice instead of once. Line doublers are principally used in the display of low-resolution images on large screen display devices, because large screen displays often have a minimum scan rate greater than that of many unaltered low-resolution images, including NTSC broadcast television. After passing through a line doubler, a signal's scan rate will be twice what it was originally. In order to produce twice as many lines without increasing the time required to do so, a line doubler traces or scans the lines twice as fast as normal.

Waveform Monitors and Vectorscopes

The waveform monitor and vectorscope provide a means to visually identify, understand, and display video signal information. They have become standard equipment used to carry out testing and maintenance of video systems and their components. These devices provide the basic tools to properly monitor and maintain video signal information. They are basically oscilloscopes modified to work specifically with video signals and provide a means to identify and learn the extent of problems with video signals and video processing equipment. Figure 3-7 is a magnified view of a horizontal line of video information as it relates to a TV screen.

A waveform monitor is used primarily to evaluate the amplitude and timing parameters of video signals, and will also show timing relationships between two or more signals. This device displays a scaled pictorial representation of an NTSC composite video signal, providing signal strength and other key monitoring information. Figure 3-8 shows a waveform monitor display of a color bar test signal.

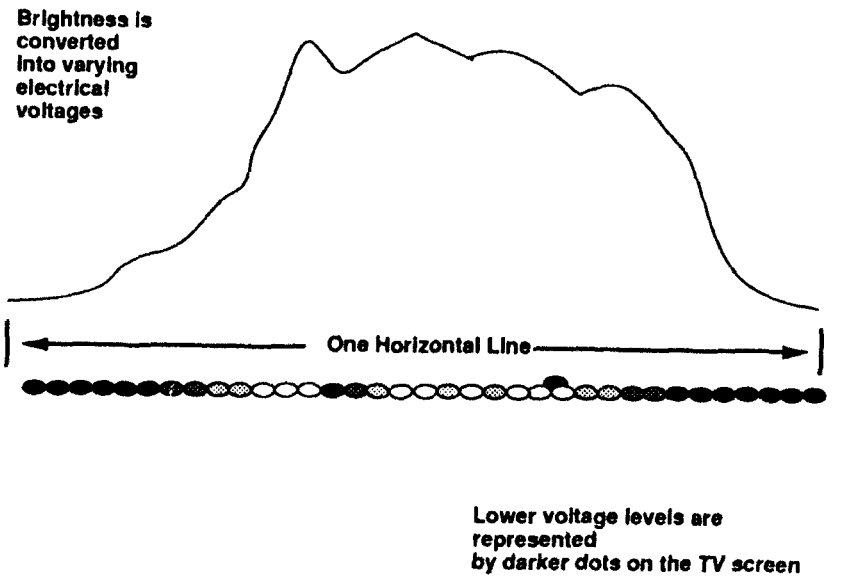


Figure 3-7. Magnified View of One Horizontal TV Line

A vectorscope displays color phase and amplitude information. In general, a vectorscope will visually show how "true" or accurate the color portion of a video signal is with regard to NTSC composite video standards. As with a waveform monitor, any deviations from a calibrated reference can be directly observed, identifying the need to correct for video signal anomalies.

Advances in broadcast video test and measurement equipment have given rise to a family of completely programmable video measuring components developed by Tektronix. The VM700A Video Measurement Set provides capabilities to completely measure and monitor all pertinent video and audio signal information, both automatically and manually. The system can operate automatically, making numerous video signal measurements, comparing results against user-defined limits, and generating hardcopy reports automatically at user-defined scheduled intervals. The device contains a built-in digital waveform monitor, vectorscope, and an RS-232 interface for complete personal computer control. The VM700A provides a laser printer port to reproduce test and evaluation results, and integrates a number of specialized tests and measurements within one piece of equipment.

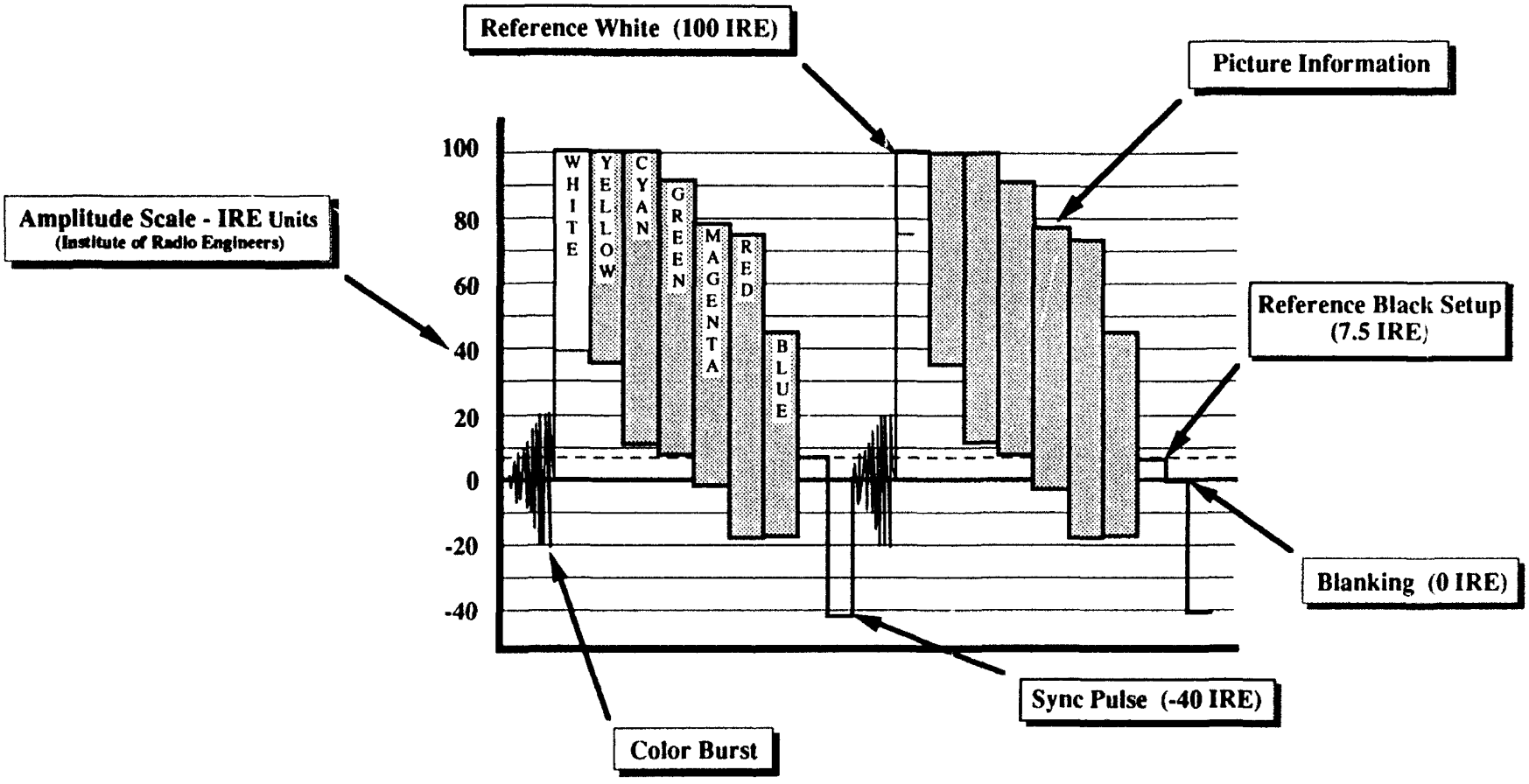


Figure 3-8. Typical Waveform Monitor Display of a Color Bar Test Signal

The evolution of products such as the VM700A continues, offering complete turnkey systems that automate all signal tests and measurements. Waveform monitor and vectorscope equipment is also moving toward more automated measuring capability, increased use of digital signal processing techniques, and integration of both devices into a single package. As a result, automated testing and maintenance checks performed on video communications systems will streamline system performance monitoring. The use of these techniques may help shorten equipment downtime for troubleshooting system components and reduce the chance of unexpected component failure.

Data Communications Processing

Data communications processing equipment is essential to data communications in the command center. Data communications processing is used to transform data into the correct format, check for and correct errors, and combine signals for transmission. Data processing equipment includes cryptographic equipment, repeaters, bridges, routers, gateways, test equipment, and multiplexers and demultiplexers.

Cryptographic equipment is data processing equipment used to encrypt classified or sensitive data. Cryptographic devices operate in pairs, with one device at each end of a physical link. The use of cryptographic equipment is usually prescribed by the systems involved and its operation is strictly controlled by NSA and other agencies. (Cryptographic devices are also discussed later in this document as part of multilevel security, under Information Processing.)

Repeaters, bridges, routers, and gateways are used to interconnect LANs. Repeaters allow a network to be extended over a long distance by repeating the digital signal along the cable pathway. Bridges are used when the protocols used on the LAN are identical or very similar. Bridges may make minor format changes, change data rates or transmission media, and provide addressing and routing information. Routers are used when the LANs are dissimilar. Routers can perform the functions of a bridge and also make significant format changes and change addressing schemes appropriately. Bridges and routers presume that a LAN uses OSI-based protocols. Gateways are used to connect OSI-based LANs with non-OSI-based LANs. A gateway operates at all seven OSI layers and makes conversions at the application (highest or most general) layer. Gateways also perform the functions of bridges and routers.

Test equipment is used to maintain, test, and troubleshoot data communication networks. In the past, testing was a lengthy process that required travelling to trouble spots. Two advances have improved the situation. Automatic test equipment (ATE) removes much of the tedium and speeds the testing process. Remote probes and modern network management software allow network testing from a central location.

Multiplexers and demultiplexers combine and separate digital signals. Many times, intersite communications pathways have significantly greater bandwidth than a single data channel in a command center. Multiplexers combine many single channels into one larger channel, and demultiplexers reverse the process. Two of the most common multiplexing schemes are time-division multiplexing (TDM) and frequency-division multiplexing (FDM). TDM gives each individual channel a fixed-length time slot and rotates from channel to channel. FDM gives each individual channel a fixed-width frequency band and translates that channel's signal into that frequency band. In FDM, each of the channels transmits continuously. Multiplexers and demultiplexers tend to be proprietary, so a matching demultiplexer must be used for each multiplexer.

COMMUNICATIONS SUBSYSTEM PRODUCTS, SYSTEMS, AND PROGRAMS

NOTE: The systems in this section are organized according to the categories provided by the command center system architecture. The category called "CINC-unique" external voice programs in the architecture has been expanded to connote those programs that serve only one site or user, regardless of whether a CINC is present there. Also, references that were produced by the Defense Communications Agency (DCA) are collectively cited under the agency's new name, the Defense Information Systems Agency.

EXTERNAL VOICE COMMUNICATIONS SYSTEMS/ PROGRAMS: DOD-WIDE

Defense Switched Network (DSN)

traffic: Switched voice

function: DSN is a subnetwork of the Defense Information System Network (DISN) providing worldwide switched and leased telephone service for DoD. The DISN is a worldwide communication system composed of three major subnetworks, the Defense Switched Network (DSN), Defense Data Network (DDN) and Defense Message System (DMS).

system description: DSN provides worldwide common-user and dedicated telephone service for DoD users. DSN is administered by DISA.

users: AUTOVON users, DoD-wide

command center components: DSN traffic is received in the command center via Autovon switches and trunks, the 304 console, and AEPDS and IEMATS devices

future growth: DSN will be upgraded to perform integrated voice and data.

reference: SOW FY 92-96, *System Engineering for the Defense Information System Network Systems Engineering and Technical Assistance*, 6 May 1991; *FY 1990 Annual Report*, DISA

Defense Satellite Communications System (DSCS)

traffic: Secure, survivable data, voice, and video

function: DSCS provides satellite transmission for DoD & government communications systems.

system description: DSCS provides voice communications connectivity on an as-needed basis independent of host nation facilities for the National Command Authority, deployed military commanders, and state department sites. DSCS is administered by DISA.

users: DoD, NCA, and U.S. government facilities in foreign nations

command center components: N/A

future growth: unknown

reference: TBD

Jam-Resistant Secure Communications (JRSC)

traffic: Survivable secure data and voice

function: JRSC provides end-to-end hardened survivable satellite communications.

system description: This multi-satellite system provides communications for voice information. JRSC serves the National Command Authority and

military commanders. Voice conferencing is supported. JRSC is administered by DISA.

users: NCA, CINCs, and deployed military commanders

command center components: N/A

future growth: unknown

reference: TBD

Secure Telephone Unit-III (STU-III)

traffic: Secure voice and data

function: A STU-III allows secure communication using the public switched telecommunication network and defense Black networks.

system description: STU-III uses voice digitization and encryption to provide clear and secure voice over standard telephone lines. The voice is digitized at 4800 bps (and at 2400 bps for compatibility with older versions). STU-III encryption is accomplished with cryptographic keys based on the FIREFLY II algorithm, which generates a unique encryption key for each call. STU-II, in contrast, relied on a centrally located key distribution center. The STU-III uses a cryptographic ignition key (CIK) that can be removed from the terminal. A STU-III terminal without a CIK can be treated as an unclassified device. The STU-III can operate at full and half duplex. The STU-III provides basic phone capabilities such as memory dialing, speed dialing, hookflash, mute, and tone or pulse dialing. Type 1 STU-IIIs are used by the government and military while type 2 STU-IIIs are for use by commercial users. Three STU-III suppliers are GE/RCA, Motorola, and AT&T. Each vendor offers unique features such as AT&T's STU Access Control System (SACS) to enable the terminal to function in a secure voice or data network or Motorola's 9600 bps full duplex secure voice. Other variations of the STU-III include a 2400 bps cellular STU-III, a STU-III mobile-cellular radio, and a host of military radios. The STU-III/R provides STU-III compatibility with a remote controlled device such as a Red Switch or a Red PABX. The STU-III/R is also used for mobile applications because of its rugged design and capability for rack-mounting.

users: All government and military users use type 1 STU IIIs. Type 2 STU-IIIs are for use by commercial users

command center components: Communication circuits and one or more STU-IIIs (a STU-III is the size of a telephone with multifunction keyboard)

future growth: Future STU-IIIs will have ISDN-like capabilities

reference: TBD

Worldwide Secure Voice Communications System (WWSVCS)

traffic: Secure voice

function: The WWSVCS provides secure voice conferencing for the U&S commands.

system description: The WWSVCS is a trusted voice conferencing system used by the NMCC for command and control functions with the U&S commands and Canadian Defence Officials. The WWSVCS uses the AUTOSEVOCOM system along with unique preemption devices controlled by the NMCC. The unique preemption devices are known as snatcher devices and use ruthless preemption to seize the appropriate circuits. The system is leased from AT&T and is monitored at the NMCC Secure Operator Consoles.

users: NMCC, ANMCC, and all U&S commands

command center components: WWSVCS components include KY-3 encryption units and snatcher boxes. The remainding components are part of existing command center Red Switching equipment and telephones. See 'DOD Red Switch Project' for more information on this equipment.

future growth: The WWSVCS uses AUTOSEVOCOM which is being phased out. The functionality of WWSVCS will be incorporated as part of the Red Switch Project Network (RSPN). See 'DOD Red Switch Project' for a discussion of the RSPN.

reference: TBD

EXTERNAL VOICE COMMUNICATIONS SYSTEMS/ PROGRAMS: CINC-UNIQUE

Automatic Remotely Programmable Conference Arranger (ARPCA)

traffic: Voice

function: ARPCA is a dedicated voice conferencing system enabling subscribers to originate a conference using the Automatic Voice Network (AUTOVON).

system description: Conference origination is accomplished from any properly class-marked AUTOVON subscriber line, or from data line terminals located in the National Military Command Center (NMCC). The data terminals allow the NMCC controller to change information stored in the bridge and to modify any existing conferences, regardless of the originator's identity. The ARPCA stores a library of conferees, and uses this information to establish 48 preset conferences.

users: EA personnel assigned to the NMCC

command center components: The ARPCA is tied in to existing Autovon trunks and controlled by two PC workstation suites.

future growth: unknown

reference: *WWMCCS Current System Description, Volume V Communications Functional Area (U)*, DISA, undated, SECRET; *NMCS Command, Control and Communications (C4) Systems Baseline Definition Catalog, Volume I, NMCC (U)*, DISA, 14 February 1986, SECRET

Command Post Alerting Network (COPAN)

traffic: Voice

function: COPAN is a dedicated telephone network designed to provide the Air Force Operations Center (AFOC) instantaneous communication with key military bases and selected commands.

system description: COPAN uses the Washington Switch, a special PBX that serves as the tactical switchboard for the DoD, JCS, and the military departments. The network is controlled from the AFOC and Air Force Emergency Operations Center (AFEOC). The AFOC/AFEOC Duty Officer can immediately contact and conference all major commands on the network in any desired combination for rapid message transmittal. Administrative calls can be routed via the Washington Switch and the individual major command switchboards over the COPAN trunk. In the event that the COPAN trunk is busy, AUTOVON or direct distance dialing (DDD) lines can be used.

The COPAN trunk terminates in large conferencing consoles at the AFOC and the AFEOC. At all major command locations, the COPAN trunk terminates in smaller (30-line) conferencing consoles. Emanating from each major command console and under the control of the duty officer is an arrangement of local lines including a quarters and office network, radio lines, and local PBX switchboard lines to provide a means of reaching selected personnel. These local lines may be added to the COPAN network individually or on a conference basis. If a trouble condition develops on the quarters and office lines, the major command duty officer receives an audible and visual signal on the line in trouble.

users: Air Force command posts

command center components: N/A

future growth: unknown

reference: AT&T Long Lines, *COPAN Operating Procedures*, January 1981; *WWMCCS Current Systems Description, Volume V Communications (U)*, DISA, undated, SECRET

COMMERCIAL EXTERNAL VOICE COMMUNICATIONS SYSTEMS/COMPONENTS

FTS-2000

traffic: Nonsecure voice, data, and video

function: FTS-2000 provides long-distance voice, data, and video transmissionS.

system description: FTS-2000 is a service provided by the Government Services Administration that offers switched voice, low speed (4800 bps) data, and switched data service (56 kbps). FTS-2000 is used exclusively instead of the public switched network in much of the government and military. Also provided by the FTS-2000 are audio conferencing, toll-free services, call rerouting, electronic mail, video transmission, and dedicated transmission lines.

users: U.S. Government and DoD

command center components: A handset for each user

future growth: FTS-2000 will provide ISDN services in the future

reference: TBD

EXTERNAL VIDEO COMMUNICATIONS SYSTEMS/ PROGRAMS

Defense Commercial Telecommunications Network (DCTN)

traffic: Secure and non-secure video

function: DCTN offers a VTC service that provides secure and non-secure video conferencing capabilities.

system description: DCTN VTC provides point-to-point and multipoint near-full-motion video conferencing in the U.S. and Europe. The DCTN VTC serves to meet defense videoconferencing requirements. Both VTC and DCTN are administered by DISA.

users: TBD

command center components: TBD

future growth: TBD

reference: TBD

Defense Satellite Communication System (DSCS)

DSCS is described under external voice communications systems.

EXTERNAL DATA COMMUNICATIONS SYSTEMS/ PROGRAMS

Air Force Integrated Digital Telecommunications Project (AFNET)

traffic: Nonsecure data

function: AFNET provides dedicated private line data for Air Force C3 requirements.

system description: AFNET will connect Air Force major commands, centers, and operating agencies using dedicated lines at rates of 56 kbps to 2048 kbps. Each node of AFNET will use an Integrated Digital Network Exchange (IDNX) device to perform automatic routing and network management. The IDNX devices will be provided with voice compression devices for cost and bandwidth allocation savings. The high data rates available through AFNET will support high speed data transport as well as digitized voice and video. The network uses channel banks to combine individual voice, data, or video channels into T-1 circuits. Multiplexers are used to convert these T-1 circuits into T-3 circuits.

users: Selected Air Force commands, centers, and operating agencies

command center components: Each AFNET node will consist of any IDNX device, a channel bank, several multiplexers as needed, and encryption devices as needed, along with echo cancelers and channel service units depending on applications.

future growth: AFNET is a proposed system and will be implemented in the near future

reference: *N.E.T. Federal AFNET Briefing*, N.E.T. Federal, Inc., 26 August 1991

Defense Data Network (DDN)

traffic: Secure data

function: DDN provides affordable, effective, secure, interoperable, and survivable long-haul information data transfer.

system description: DDN is a part of the Defense Information System Network (DISN), a worldwide communication system. The Defense Switched Network (DSN) and the Defense Message System (DMS) are also a part of DISN. DDN consists of 4 subnetworks: MILNET (unclassified, national security related DoD traffic); DISNET (SECRET level traffic); WIN (TOP SECRET level traffic); and SCINET (traffic above TS). DDN uses 56 kbps or 50 kbps dedicated data circuits. The DDN is used to transport data between military departments' computer systems. The AUTODIN system currently provides multilevel secure data communications for the DDN. DDN is administered by DISA.

users: DoD data users

command center components: DDN traffic is brought into the command center via IEMATS and AEPDS terminals

future growth: Separation of differing levels of classified traffic will be ensured through the use of end-to-end encryption devices, such as BLACKER

reference: SOW FY 92-96, *System Engineering for the Defense Information System Network Systems Engineering and Technical Assistance*, 6 May 1991; *FY 1990 Annual Report*, DISA

Defense Message System (DMS)

traffic: Secure data messages

function: DMS provides integrated DoD message capability (merged AUTODIN organizational messages and DDN individual electronic mail).

system description: DMS comprises all hardware, software, procedures, facilities, and personnel that support messaging, AUTODIN, and electronic mail. The old AUTODIN has been absorbed by DMS. Some functions previously performed by DDN are now performed by DMS. DMS is administered by DISA.

users: DoD data users

command center components: DMS traffic is brought into the command center via IEMATS and AEPDS terminals

future growth: The goal is for DMS to be a fully automated service based on X.400/X.500 communications standards

reference: SOW FY 92-96, *System Engineering for the Defense Information System Network Systems Engineering and Technical Assistance*, 6 May 1991; *FY 1990 Annual Report*, DISA

Defense Satellite Communications System (DSCS)

This system is described under external voice communications systems.

Jam-Resistant Secure Communications (JRSC)

This system is described under external voice communications systems.

CINC Secure Fax

traffic: Secure data

function: This system provides secure fax capabilities.

system description: This system uses STU-IIIs and special fax equipment to send and receive secure facsimiles over standard telephone lines. The facsimile equipment operates at 2400 bps. CINC Secure Fax is administered by the Air Force.

users: U&S commands

command center components: STU III telephone, secure facsimile terminal

future growth: TBD

reference: TBD

Automated Weather Distribution System (AWDS)

traffic: Nonsecure data

function: AWDS provides National Weather Service weather information.

system description: Data for AWDS is collected at and disseminated from an Automatic Digital Weather Switch via the Automated Weather Network. It provides basic weather information for command centers' briefing preparers and operational planners. AWDS is administered by National Weather Service.

users: DoD and federal government

command center components: Communication circuits, with access to the data through an IPS host computer

future growth: Enhanced capability will keep pace with increases in automated weather prediction systems

reference: *Automated Weather Distribution System Concept of Operations (U),* 03/31/90

Fleet Satellite Communications (FLTSATCOM) System

traffic: Survivable voice and data

function: FLTSATCOM provides worldwide tactical two-way communications for high-priority, UHF/SHF communications users.

system description: FLTSATCOM terminals vary in size and complexity, depending upon the communications requirements of each location. The FLTSATCOM system provides protection against jamming and resistance to electromagnetic pulse. Although any part of the system may be operated as a separate entity, the integrated system provides connection for message traffic and voice communications to DoD long-haul communications networks.

users: Naval aircraft, ships, submarines, and ground stations; Air Force Strategic Air Command (SAC) bombers and rapid deployment forces; and presidential networks

command center components: Communication circuits, with access to the data through an IPS host computer

future growth: Enhanced FLTSATCOM satellites will be fielded

reference: *Fleet Satellite Communications System, USAF Fact Sheet 86-205,* HQ AFSC, Office of Public Affairs, 1 January 1986

Air Force Satellite Communications (AFSATCOM)

traffic: Secure data

function: The primary functions of AFSATCOM are dissemination of EAMs, communication among the U&S commanders and the NCA, command and control of the force elements committed to the Single Integrated Operation Plan (SIOP), and report-back from the SIOP force elements.

system description: Each AFSATCOM transponder has 12 narrowband channels for specific user functions. The first seven narrowband channels are used for EAM dissemination, force direction, and force report-back for SIOP/nuclear-capable forces. The next four narrowband channels are assigned to support essential operations of non-SIOP high priority Air Force users. The twelfth narrowband channel is used for system control. SIOP terminals

provide half-duplex TTY operation via the 5 kilohertz (kHz) narrowband satellite channels.

Normal force terminals (airborne and ground) provide half-duplex TTY operations via a 5 kHz, fixed frequency satellite channel.

Command post terminals can send, receive, and monitor messages, initiate EAMs, and operate in a network control system. They can also monitor and record all reportable data to allow command transition. These terminals use full-duplex TTY operation on the 500 kHz wideband channel, along with half-duplex and full-duplex TTY on the 5 kHz narrowband channels.

users: Air Force components, National Command Authority, the NMCS, CINCs and their components

command center components: Modular terminals, antennas and power supplies (varying in size and type, depending on the requirements of the terminals they service), a keyboard, teleprinter, and appropriate control/monitor panels.

future growth: Enhanced, integrated FLTSATCOM satellites to be fielded will provide additional capability for AFSATCOM; MILSTAR will be the follow-on for AFSATCOM.

reference: AFSC, Office of Public Affairs, AF Satellite Communications System, USAF Fact Sheet 85-201, August 1985; *WWMCCS Current System Description, Volume V, Communications Functional Area (U)*, DISA, undated, SECRET

Automated Weather Network (AWN)

traffic: Data

function: The AWN is a global network used in the collection and dissemination of environmental data to support the Air Weather Service mission. The network is also the prime system for the collection and dissemination of notice-to-airmen (NOTAM) messages pertinent to navigational facility status.

system description: TBD

users: TBD

command center components: TBD

future growth: TBD

reference: *WWMCCS Current System Description, Volume V, Communications Functional Area (U)*, DISA, undated, SECRET

Milstar Satellite System

traffic: Survivable data

function: Milstar is designed to provide a worldwide, highly jam-resistant, survivable, and enduring satellite communications capability.

system description: Milstar uses both geosynchronous orbit and highly elliptical polar orbit satellites to ensure continuous coverage for bombers and submarines in all levels of conflict. Milstar serves as a bridge between forces belonging to different branches of the military. Milstar satellites are switching centers in space, controlling access to the system, routing messages to end users, and creating crosslinks among the satellites themselves. They search for potential users automatically, scanning the earth with narrow beams that hop from spot to spot. They can function autonomously. If control centers on earth were to be destroyed, MILSTAR satellites could maintain their positions for months. The crosslinks will enable Milstar satellites to relay messages around the world above the atmosphere without reliance on intermediate downlinks to vulnerable ground stations.

Milstar uses several techniques to withstand jamming: EHF transmissions, frequency hopping, and error coding.

users: NCA and the CINCs in the command and control of U.S. strategic and tactical forces.

command center components: MILSTAR data will enter the command center through AEPDS, SCIS, and ANDVT devices

future growth: TBD

reference: TBD

DOD Red Switch Project

traffic: Secure voice

function: The DoD RSP provides secure switching and voice services.

system description: The Red Switch Project (RSP) provides secure voice services for command center users at all U&S commands. The RSP is part of the Secure Voice System (SVS), along with the STU-III project. The RSP provides a standard Red digital telephone switch. Unencrypted secure communications is permitted within a red enclave while communications outside the enclave are encrypted. The Red Switches operate at Secret-system-high and are capable of simultaneous operation at higher levels, including SCI. The DOD RSP serves as an interface point for command center secure communications, providing access to distant-end remote users, other Red Switches, STU-IIs, STU-IIIs, KY-57/58, KY-68/78, SVTs and ANDVTs. This provides interface capabilities for all types of secure voice systems including unique and tactical networks.

users: DOD and some federal government users

command center components: The Red Switch system consists of the Red Switch and all associated remote equipment, interfaces, subscriber instruments and command center consoles. In addition, encryption devices are required for each outside line connected to the Red Switch. The Red Switch subscriber instruments are digital multi-line telephone handsets that provide both Red and Black service. Red service is provided from the Red Switch while Black (nonsecure) service is provided from a Black Key System (BKS) to nonsecure telecommunications lines, such as DSN, commercial service and FTS. Thus, the command center user is provided with a single integrated instrument to access all desired services whether secure or nonsecure.

future growth: The AF has hundreds of Red Switches at various sites. These switches may be integrated with the RSP into one network called the RSP network (RSPN). The DOD RSP will be augmented with Integrated Digital Network Exchange (IDNX) devices at each Red Switch location that perform automatic routing and network management functions.

reference: *Red Telephone Switching Subsystem Program Description*, HQEID/AGR, undated

Minimum Essential Emergency Communications Network (MEECN)

traffic: Survivable data

function: MEECN is designed to transmit EAMs as a last-resort communications system if all other systems fail during a nuclear attack. MEECN is a highly survivable, very-low-frequency (VLF) ground-wave network used only for slow-speed, low-data-rate communications.

system description: MEECN is an evolving network of diverse communications systems. MEECN systems and their interconnectivity are classified.

users: National Command Authority, all nuclear-capable components

command center components: classified

future growth: This network of communications systems will evolve to match changing technology and crisis reaction procedures.

reference: *Descriptions of MEECN and MEECN Supporting Systems (U)*, TM178-80, DISA/CCTC, 15 April 1980, SECRET.

Washington Facsimile (WASHFAX IV)/WASHFAX IV (Interim)

traffic: Secure data

function: The WASHFAX program allows secure fax transmission between sites in and around the Washington, DC area.

system description: WASHFAX IV (Interim) is the current states of development of the WASHFAX program. It is the collection of group IV facsimile machines and commercial land-line communications circuits operating at 56 kbps over leased land lines. WASHFAX provides a means of exchanging classified graphics data between operations and intelligence centers. WASHFAX is especially important for coordination in crisis situations.

users: Government and DoD users in Washington, DC area

command center components: A group IV fax transceiver and COMSEC equipment for each subscriber in the command center are required

future growth: Full WASHFAX IV capability will be realized through a general technology upgrade by 1993.

reference: *NMCS Current System Description (U) Vol III*, January 1989; NMCS Engineering Workstation (NEWS) database query, August 1991

North American Aerospace Forward Automated Reporting System (NFARS)

traffic: Secure data (teletype)

function: NFARS provides nuclear TW/AA information to users.

system description: NFARS is an automated, dedicated, secure teletype system over which missile warning information, nuclear detonation messages, and CONUS Airborne Reconnaissance for Damage Assessment reports are disseminated to subscribers. Low-speed transmission provides reliable warning information to this teletypewriter system. NFARS is administered by the Air Force.

users: CINCs, U&S commands, NEACP, SAC ABNCP

command center components: Typically, a channel interface unit, data set adapter interface, modem, COMSEC equipment, and access to RED patch panel. A printer and data recorder are also needed.

future growth: TBD

reference: *NMCS Current System Description (U) Vols. III and IV*, January 1989

Command Post Record Capability (COPREC)

traffic: Secure data

function: COPREC provides direct, secure, command post to command post record communications in support of the USAF Emergency Actions File (USAF-EAF).

system description: This system will permit transmission of message traffic over any voice medium available to the command posts. COPREC provides direct command post to command post secure message capability. By converting encrypted data to voice tones, a secure message can be sent over a voice line. Access to a voice line is gained by making the voice/data terminal an extension of the EA consoles located in the command post of major air commands.

users: Air command headquarters command posts, Air Force Command Post, Air Force Alternate Command Post, the AFEOC Command Post, Alternate HQ to US Forces - Europe, and Pacific Air Force

command center components: COPREC telephone set, A/D and D/A converter, a voice/data switch, a teletype set modified for low-level keying, teletype interface box, cryptographic equipment

future growth: TBD

reference: *WWMCCS Current System Description, Volume V, Communications Functional Area (U)*, DISA, undated, SECRET

PART 4. INFORMATION PROCESSING

INTRODUCTION

A command center is primarily a place for information exchange. Its effectiveness is almost totally dependent upon the quality of information it receives and processes and the ability of the staff to interact both with the information and with the decision maker. Command center functions and activities that support information exchange are identified and discussed below, together with typical information processing subsystem upgrading objectives designed to support an improved information exchange capability.

Command Center Information Processing

The IPS is where command center data is accessed, analyzed and processed. Data is stored in host computers. User workstations have access to these host computers and to each other. The user workstations may be composed of a variety of vendor products that are interoperable because the products meet the same standards. The goal of information processing is to provide all authorized users with all command center information from any given workstation transparently and with maximum efficiency. In addition, the FDDI backbone LAN, which links the three information-related subsystems (communications, IPS, and BDS), and the IPS LAN are a part of the Information Processing Subsystem. Computer and communication standards are necessary to realize this objective configuration.

The execution of typical command center functions and activities that support the vital process of information exchange and decision-making constitutes the command center information cycle. The cycle can be initiated by an external event, a decision maker's request, or a routine information exchange. As illustrated on the left side of Figure 4-1, data elements are selected from the resident database and updated as appropriate by real-time entries and/or access from other related sources. On the right side, the selected data elements are correlated and incorporated into information summaries (e.g., displays) useful and pertinent to the decision maker in formulating decisions and directives. The cycle is completed by staff action and associated reports that flow back into the command center database.

The command center information cycle can be effective in meeting the needs of a decision maker only to the extent that personnel using, managing, and operating the associated command center's systems are successful in the performance of their tasks. The functional elements of the command center information cycle, as typically performed and supported today, are discussed as they relate to the required capabilities and elements defined in the command center system architecture. These capabilities are shown in Figure 4-2.

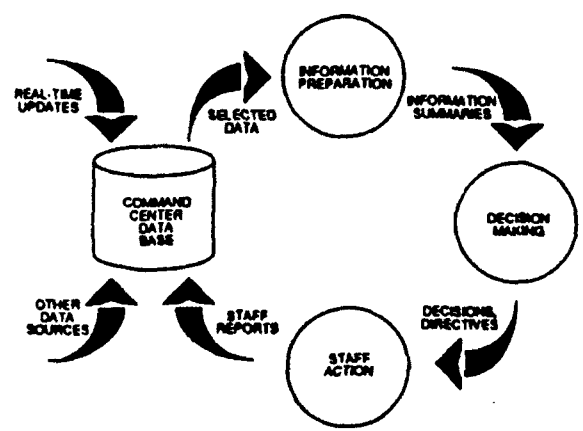


Figure 4-1. The Command Center Information Cycle

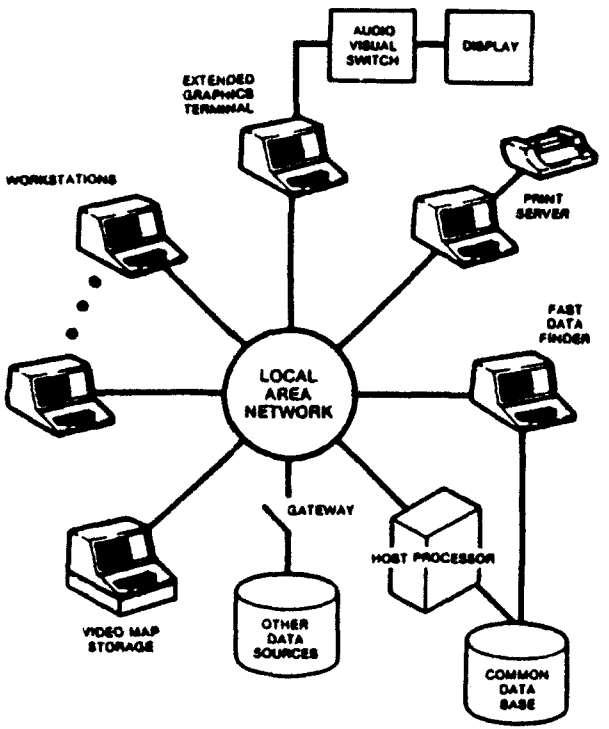


Figure 4-2. Upgraded Information Processing Capability

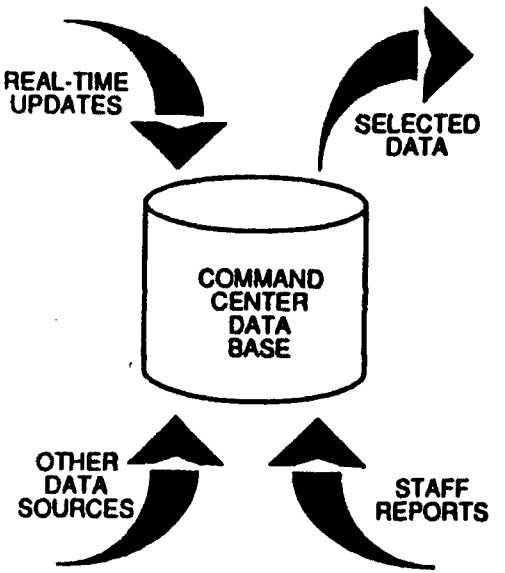


Figure 4-3. Data Resource

The information processing capabilities required to support automated information processing subsystem functions are listed in Figure 4-3. These have been reduced to five general upgrading objectives, as follows:

- Provide wide access to ADP capabilities
- Enhance message handling and information flow
- Provide automated access to internal and external information systems
- Provide automated briefing preparation support
- Provide a capability for sharing command center data and ADP resources.

Information Processing Standards

In order for devices to communicate with each other, they must be able to initiate contact, follow the same rules of communication, understand each other, and have a mechanism for error detection and correction. In order for information processing systems to be interactive on a network, the same requirements hold, and application translation must also be possible. Communications and information processing standards are an attempt to define how these requirements will be fulfilled. Standards relevant to the IPS are listed in Figure 4-4. (Many of these standards involve aspects of both the communications and information processing subsystems and consequently appear in both sections.) These standards are put forth by a number of standards bodies, the most important of which are: DoD, the American National Standards Institute (ANSI), Electronic Industries Association (EIA), Institute of Electrical and Electronics Engineers (IEEE), International Organization for Standardization (ISO), International Telegraph and Telephone Consultative Committee (CCITT), National Communications System (NCS), and National Institute of Standards and Technology (NIST).

Because they are both established on essentially the same electronic technology foundation, the communications and information processing arenas share many standards, such as the OSI reference model. Information processing standards generally reside in OSI layers two through seven. Standards that describe the physical and electrical connectivity required between two electronic devices (layer one in the OSI reference model) are called interface standards. Protocol standards describe rules that allow communications equipment to understand each other (layers two through seven). A complete discussion of the OSI reference model and other shared standards is contained in the Introduction to Part 3.

GOSIP, POSIX, and APP

GOSIP is a set of data communication standards based on the OSI reference model. Use of GOSIP is required for federal government users. Although GOSIP is not mandatory for DoD, its prevalence in the federal government will increase its use in other markets and reduce the costs of GOSIP-compatible equipment. GOSIP Version 2.0 is defined in the NIST Federal Information Processing Standard Publication No.146. GOSIP 3.0 has been finalized by standards organizations and will soon be the standard required for by non-DoD parts of the federal government.

For a distributed information processing system to be fully interoperable requires more than the standard data communications provided by GOSIP. There is also a need for standard operating systems and software. The Portable Operating System Interface for Computer Environments (POSIX) and the Applications Portability Profile (APP) fill this remaining need. POSIX provides a vendor-independent interface between software applications and operating systems. APP specifies interfaces between the operating system and networking services. Together, GOSIP, POSIX, and APP provide users with a full tool set for developing interoperable, distributed systems for heterogeneous computing platforms. APP is an emerging standard; it is the model that will be used in the FY 92 version of the command center system architecture.

Users of GOSIP can build a protocol suite best suited for their needs by selecting protocols from each of the seven layers. Only OSI protocols that have reached draft or final approval from ISO. This ensures that products based on GOSIP will not be subject to changes as the standards change.

EXTERNAL DATA INTERFACES

The command center system architecture depicts external data interfaces as a component capability of the information processing subsystem. However, in a practical sense external data interfaces are inputs to, rather than parts of, the information processing subsystem. These inputs may originate outside the command center and can be routed through the communications subsystem via the FDDI backbone.

STANDARD	TITLE	DESCRIPTION	NOTES
ANSI/IEEE 802.1 (final, 1989)	Standard for Local Area Networks: Token Ring Access Method and Physical Layer Specifications *method*	Comprehensive standard for LANs. using token-passing ring access. Will aid interconnection of data processing *equipment*	Same as IEEE 802.5 and similar to ISO 8802.5
ANSI/IEEE 802.2	Standard for Local Area Networks: Logical Link Control	Describes protocol of the logical link control sublayer of the data link layer of an OSI LAN protocol	Similar to ISO 8802.2 and forms a part of NIST FIPS PUB 107. Same as IEEE 802.2
ANSI/IEEE 802.4 (final, 1985)	IEEE Standard for Local Area Networks: Token-passing Bus Access Method and Physical Layer Specifications	Comprehensive standard for LANs using token-passing bus access method	Same as IEEE 802.4 and similar to ISO 8802-4.2
ANSI X3.139 (final, 1987)	FDDI Token Ring Media Access Control (MAC)	Protocol standard for high-performance multi-station *networks*	Similar to ISO 9314-2
ANSI X3.148 (final, 1988)	FDDI - Physical Layer Protocol (PHY)	Physical interface standard for FDDI	Similar to ISO 9314-1
CCITT X.400 (final, 1988)	Message Handling Systems - System Model - Service Elements	Describes service elements of the message handling system	Commonly called e-mail
CCITT X.500 (final, 1988)	The Directory - Overview of Concepts, Models and Services	Maintains a database of e-mail users; provides global directory assistance so e-mail users can contact each other	
IEEE 802.2 (final, 1985)	Standard for Local Area Networks: Logical Link Control	See ANSI/IEEE 802.2	
IEEE 802.4 (final, 1985)	IEEE Standard for Local Area Networks: Token-Passing Bus Access Method and Physical Layer Specifications	See ANSI/IEEE 802.4	
IEEE 802.5 (final, 1989)	Standard for Local Area Networks: Token-Passing Bus Access Method and Physical Layer Specifications	See ANSI/IEEE 802.4	
IEEE 802.7 (draft, 1986)	Broadband Local Area Network Recommended Practices	Specifications for interface and low-level protocol for a LAN	Works in conjunction with IEEE 802.2

Figure 4-4. Information Processing Subsystem Standards

STANDARD	TITLE	DESCRIPTION	NOTES
ISO 3309 (final, 1984)	High-Level Data Link Control Proc. - Frame Structure	See ISO 4335	Similar to ANSI X3.66
ISO 4335 (final, 1987)	High-Level Data Link Control Elements of Procedures	Defines operational modes and control procedures of HDLC. Key standard for ISO HDLC protocol.	Works with ISO 3309, ISO 7809 and ISO 8885 to form HDLC protocol
ISO 7809 (final, 1984)	High-Level Data Link Control Proc.- Consolidation of Classes of Procedures	See ISO 4335	Replaces ISO 6159 and ISO 6256
ISO 8072 (final 1986)	Open Systems Interconnection - Transport Service Definition	Defines service provided to the session layer from the transport layer. Defines the service characteristics of the connection establishment, data transfer, and disconnection phases	Part of the Connectionless Network Layer Protocol, along with ISO 8473, and ISO 8602). Similar to CCITT X.214
ISO 8073 (final 1988)	Open Systems Interconnection - Connection Oriented Transport Protocol Specification	Specifies connectionless-mode protocol. Provides end-to-end guaranteed delivery of user data transparently and masks the differences of the network types from the service user	Connectionless-mode information included in a 1989 addendum to the protocol. Similar to ANSI X3.14 and CCITT X.224
ISO 8348 (final 1987)	Data Communications - Network Service Definition	Defines the connectionless-mode service provided by the Network Layer to the Transport layer	Connectionless-mode information included in a 1987 addendum to the standard. Similar to CCITT X.213
ISO 8473 (final, 1989)	Data Communications - Protocol for Providing the Connectionless-Mode Network Service	Defines functions and procedures for a connectionless-mode network service	Similar to CCITT X.213
ISO 8571 (final 1988)	Open Systems Interconnection - File Transfer, Access and Management	Describes a file transfer process. Includes feature descriptions, a description of how to describe files, the externally visible file transfer and error recovery protocol	

Figure 4-4. Information Processing Subsystem Standards, continued

STANDARD	TITLE	DESCRIPTION	NOTES
ISO 8602 (final, 1987)	Open Systems Interconnection - Protocol for Providing the Connectionless-Mode Transport Service	Defines procedures necessary to provide the transport connectionless-mode service	
ISO 8613 (final 1989)	Text and Office Systems - Office Document Architecture (ODA) and Interchange Format (ODIF)	This standard defines how office documents, such as reports, letters, invoices, etc. will be interchanged by means of data communications or the exchange of storage media	Similar to CCITT T.73 and CCITT T.411
ISO 8802-3 (final, 1989)	Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications	Comprehensive standard for LANs using CSMA/CD as the access method. Encompasses several media types at rates of 1 Mbps to 20 Mbps, nominal at 10 Mbps	Supersedes IEEE 802.3
ISO 8885 (final, 1987)	High-Level Data Link Control Procedures- Gen. Purpose XID Frame Info Field Content & Format	See ISO 4335	
ISO 9040 (final 1990)	Open Systems Interconnection - Virtual Terminal Service	Allows a PC or workstation to act as an IBM 3270-type dumb terminal and thus access mainframe data and *applications*	
ISO 9596 (final, 1990)	Open Systems Interconnection - Management Information Protocol Specification - Common Management Information Protocol	CMIP is a protocol providing communications between computing devices and a central management station on a network	
MIL-STD-1777 (final, 1983)	Internet Protocol	Protocol standard specifies the Internet Protocol (IP) that supports the interconnection of communication subnetworks	Together with MIL-STD-1778 forms forms the TCP/IP protocol
MIL-STD-1778 (final, 1983)	Transmission Control Protocol	Protocol standard specifies a transport protocol for use in packet-switched networks	Together with MIL-STD 1777 forms the TCP/IP protocol
MIL-STD-1779 (final, 1989)	Interfaces for High Capacity C3 Local Area Networks	Specifies physical interfaces for high capacity command, control, and communication local area networks	

Figure 4-4. Information Processing Subsystem Standards, continued

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STANDARD	TITLE	DESCRIPTION	NOTES
MIL-STD-1780 (final, 1984)	File Transfer Protocol	FTP is an application for TCP/IP that supports transfer of file data throughout a heterogeneous host computer network	
MIL-STD-1781 (final, 1984)	Simple Mail Transfer Protocol	SMTP is an application for TCP/IP that transfers electronic mail	
MIL-STD-1782 (final, 1984)	TELNET Protocol	An application for TCP/IP that is a terminal emulation protocol	
MIL-STD-188-161B	TBD	Specifies secure facsimile standards	
NIST FIPS PUB 146 (final, 1988)	Government Open Systems Interconnection Profile (GOSIP)	A standard reference for all federal govt. agencies for ADP and communication systems or services	
NIST FIPS PUB 151 (final, 1988)	Portable Operating System Interface (POSIX)	Defines a comprehensive set of facilities that users need to develop and operate portable applications	

Figure 4-4. Information Processing Subsystem Standards, continued

INTERNAL DATA INTERFACES

The term "internal data interfaces" denotes connectivity that is established through the IPS LAN. Internal data interfaces enable the transfer of information from one piece of information processing equipment to another, or the sharing of data resources among machines. Issues influencing how internal data interfaces are implemented in the command center include file compatibility, procedures to control simultaneous access and manipulation of a single file by multiple users, and system administration. Necessary system administration tasks are the assignment of access levels and data manipulation privileges (such as read-only or read-write) to users. Many of these same issues are multilevel security considerations. In the command center environment, a determination of a user's access to data based on job functions often becomes associated with that user's clearance level and need-to-know.

AUTOMATED MESSAGE HANDLING

During periods of enhanced activity, messages may flow into the command center at a rapid pace. The watch officer or a crisis team chief must make internal distribution decisions and assign staff responsibility for responding to action messages. In some situations, command centers receive all messages from the communications center in hard copy form. Internal distribution is made by reproducing additional copies and hand-delivering the messages to appropriate command center operators. This is a slow and cumbersome process which dramatically impacts the time available for preparation of a coordinated response, especially in times of crisis.

Automated message handling offers the potential for eliminating a time-consuming task while reducing the risk that an important message or common thread in a series of messages might be missed. AMH software can provide the following capabilities:

- Sorting and queuing messages by priority.
- Executing internal distribution according to addressee, using an electronic mail capability.
- Comparing messages against user profiles and routing messages accordingly. A user profile is a list of standard topics that reflects the job function of each user.
- Sorting and routing messages in response to short-term queries. The system can perform this operation both on messages as they arrive and on archived messages.
- Archiving the messages for future reference.
- Manage the staffing and coordinating of outgoing messages prepared in response to incoming action messages. The capability should allow the coordinating elements to amend or annotate the proposed response and signify concurrence when necessary. Once approved by a releasing officer, outgoing messages should be sent electronically to the communications center for release into the AUTODIN system.

An AMHS will be most useful to the organization it supports if it is easy to use and tolerant of uncertainty. Some systems provide a Soundex capability, which allows the user to type a phonetic approximation of a name or term, then determines the correct spelling and retrieves messages accordingly. Systems that understand natural-language queries rather than expressions using Boolean logic operators (such as AND, OR, ≠) are also more user-friendly.

An organization that implements an AMH system can use a scanner equipped with optical character recognition software to convert existing message records to the new system. There should be on-line access from the communications center to the command center such that all new messages can be forwarded electronically to the system.

Currently available AMHS products include the Verity Topic system, Logicon Message Dissemination System (LDMS), and Consular Lookout and Support System (CLASS).

MULTILEVEL SECURITY

Multilevel security is a capability of automated systems that involves the separation and protection of secure information. An MLS system simultaneously processes information of different security levels and controls access to information based on user clearances and need-to-know. MLS is a critical need in command centers, and significant effort has been expended to develop hardware and software to provide the capability. A number of products hold the potential to contribute to MLS systems, but complete, fully functional MLS systems are not yet a technological reality. The target command center architecture projects that two-level secure processing – that is, the concurrent processing of data at two adjacent security levels, such as Confidential-Secret or Secret-Top Secret – will be available within five years. Figure 4-5 illustrates the projected development of MLS technology.

Technical Overview

MLS is strongly based on the concept of trusted computer systems. Trusted systems are defined as those systems for which assurances are provided that security requirements are correctly implemented, security mechanisms are tamper-resistant, and security services are not circumventable. The term "trusted" often is used to describe a product that has been certified by the National Security Agency as providing a specified level of security according to DoD 5200.28-STD.

Because a trusted system processes information for which some users may not be cleared, it must correctly enforce the access controls to prevent compromise. For a system to be adequately trusted, security features and assurances must be provided in its design and implementation. DoD standards define several levels of trust for general-purpose computer systems. Interpretations of those criteria have been developed for networks, network components, and database management sustems. MLS systems comprise trusted components interconnected to enforce security policies across the system. Technology to support MLS information systems can be categorized as follows:

- Trusted operating systems
- Trusted networks
- Trusted workstations

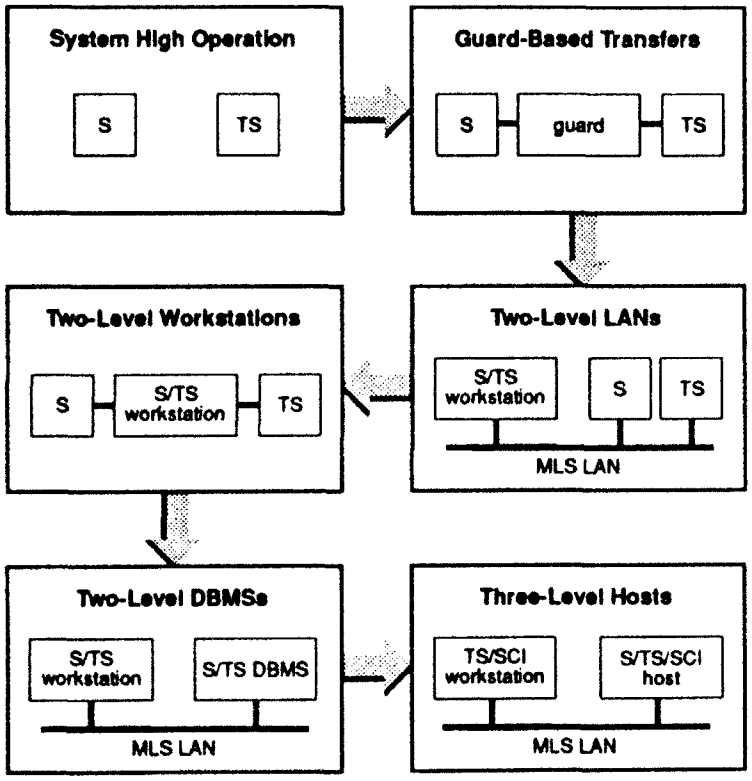


Figure 4-5. MLS Technology Development Steps

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- Trusted DBMSs
- Trusted applications
- Secure system interfaces
- Secure system integration.

Trusted operating systems provide the foundation for most components in MLS systems. Operating systems typically support process management, file system management, and input/output processing, and are found in mainframe computers, minicomputers, workstations, and microcomputers (i.e., PCs), all of which may be platforms for MLS components. Trusted operating systems are needed not only for each of these platforms, but also to support distributed architectures and computer networks.

Trusted networks provide secure data communication services between components in information systems. Networks form the backbone for distributed systems of all types. Networks are composed of numerous elements, such as cabling, communication protocols, terminal servers, bridges, routers, repeaters, gateways, and media access units. In an MLS system, several of these elements will be trusted to enforce the security policy. Special emphasis has been placed on communication protocols, which have the most complex role in providing services in MLS systems. This emphasis spans the entire network model, from physical interfaces to network application services such as electronic mail, file transfer, and remote terminal access.

The technology underlying MLS LANs is advancing rapidly. NSA-endorsed LAN encryption units, such as the Xerox Encryption Unit and Motorola Network Encryption System, are now available that allow systems operating at different security levels to be supported by a single LAN. Two MLS LANs have also been evaluated by NSA. LANs under development are following the IEEE 802.3 standard (see standards chart in the introduction to Part 4).

Trusted workstations can be considered a hybrid class of components in an MLS system that supports distributed architectures. Workstations include a hardware platform (typically microprocessor-based with mass storage and display capabilities), operating system, application software, and network interface, each of which is addressed as a separate area of interest in this section. Trusted workstations generally fall into three categories:

- Workstations that provide a trusted MLS operating system

- Workstations that provide both a trusted MLS operating system and a trusted MLS window management function
- Workstations that provide both a trusted MLS operating system and a trusted MLS window management function, and also meet Defense Intelligence Agency (DIA) Compartmented Mode Workstation (CMW) requirements.

Trusted database management systems provide data management services for information at multiple security levels while protecting the confidentiality and integrity of the data. The DBMS is an important class of system application that warrants special attention. A trusted DBMS relies on the underlying trusted operating system as the basis for DBMS-related security services and assurances.

Trusted applications are needed to provide MLS functions not supported by the operating system, such as user interfaces and data reclassification capabilities. Current MLS development efforts are primarily concerned with trusted user interface management systems (UIMSs), graphics capabilities, and data reclassification capabilities (i.e., sanitization and downgrading).

Secure system interfaces allow information flow across security boundaries, such as between systems operating at different security levels. In DoD systems, secure interfaces are required to support joint operations and C3I activities. For example, commands often require automated connectivity between their C3I systems and other DoD C3I systems. In addition, this area of interest extends to interfaces with wide area networks (WANs), such as DDN, AUTODIN, and the WWMCCS Intercomputer Network (WIN). Interfaces that provide bidirectional information flow are needed to satisfy most operational requirements. Near-term research and development are focusing on the area of secure system interfaces, especially to achieve essential C3I capabilities.

Secure system integration addresses designing, implementing, and operating MLS systems as combinations of individual components, such as operating systems, networks, DBMSs, workstations, applications, and interfaces. Important aspects of secure system integration involve auditing, authentication, access controls, and labeling among multiple components in a networked or distributed information system.

MLS Issues

The design, development, implementation, and integration of MLS in the command center environment requires consideration of all disciplines of information security: communication, computer, emanations, personnel, physical, and administrative security. Some technical and operational issues that MLS raises are discussed in the following paragraphs.

Technical Issues

Trusted products: The computer industry currently does not provide trusted computer systems, trusted network components, secure communications equipment, and trusted applications to support all the immediate needs in DoD. The products that currently exist support a small set of hardware platforms and provide low levels of trust; products to support other hardware platforms and higher levels of trust have not yet been developed. Therefore, an incremental approach must be taken to realize partial MLS capabilities while industry catches up with the demand through research and development.

A guide to available MLS products is the *Information Systems Security Products and Services Catalogue*, prepared by NSA. It lists evaluation results for a wide range of security products and provides manufacturer point-of-contact information.

Security Standards: Government and industry are developing standards for open system architectures under the Secure Data Network System (SDNS) program. However, off-the-shelf, interoperable products from this effort are several years off, leaving a hole in the provision of communications security services (e.g., data confidentiality, data integrity) for MLS systems. Near-term solutions to communications security services such as LAN encryption systems may not be compatible with SDNS solutions, and therefore may require replacement when SDNS products become available. An effective approach is to begin the migration to target government networking standards, such as GOSIP, to minimize the modifications required once those standards are enhanced with SDNS security standards. However, short-term solutions may still be required to provide needed security services until long-term solutions are available.

System Performance: While systems can be implemented to satisfy security requirements, a successful implementation will also meet the sys-

tems' operational requirements. In general, systems pay a price in performance when security services are implemented. An MLS system will impose additional burdens on processing elements, communications channels, and storage units. The performance penalty imposed by security services will only be overcome when faster technologies or new techniques are developed by industry for implementing security.

Integration of MLS into Existing Systems: Existing C3 systems must operate continuously to fulfill their critical missions. To upgrade a system in continuous operation, the system integrator must use an approach that maintains current operations while new capabilities are being installed and tested. An MLS testbed and prototyping facility, currently supported by DISA, provides an avenue for MLS system development and testing before the system is integrated into the operational environment. Some of the MLS products currently available, such as the BLACKER Front-End (BFE) underwent extensive development and testing at the DISA testbed.

Operational Issues

User Operations: The introduction of MLS components into an existing system impacts the manner in which users access the system services. New user interfaces are provided, requiring users to consider session security levels, terminal security levels, and other access control parameters. To prepare the user community for the changes, training must be provided before the MLS functions enter full-scale application.

Personnel Security: The inclusion of MLS components in a system does not automatically reduce personnel security requirements, such as minimum allowable user clearance. The level of trust placed in the system and the range of information sensitivity processed by the system dictate the minimum user clearance allowed for accessing the system.

Local Programming: An MLS system cannot protect information if the security services are circumvented or violated. Local programming, an operational necessity in some applications, can violate system security if installed, for example, with privileges to allow direct access to operating system resources. The site security managers must ensure that installed programs are subject to the same security controls as other user processes. Trusted software (e.g., software subjected to security analysis and testing) must be used when additional privileges are required. Local programmers and system managers must be educated about the risks involved with untrusted, privileged software.

Joint MLS Technology Insertion Program

The Joint MLS Technology Insertion Program provides a vehicle within the Department of Defense to promote the development and implementation of MLS solutions for DoD information systems. The overall goal of the program is to develop and deploy components and technologies that will allow the DoD to meet operational and MLS requirements for their C2 systems. The program is managed by DISA, with sponsorship and oversight from the Assistant Secretary of Defense for C3I and the JCS/J6. NSA/V3 is the security technical coordinator for the program. The joint MLS program office provides up-to-date information and other services for Service and agency MLS problems.

LOCAL AREA COMMUNICATIONS

The IPS function of local area communications consists of the IPS system LAN and the FDDI backbone network that links all three subsystems. Local area networks (LANs) are communication networks that allow computers and electronic devices within a small geographic area to communicate and share information and resources. LANs have become very popular as military, government and commercial users have recognized their importance. LANs allow users from different points in the command center to share database information rather than maintaining separate databases. LANs allow users to share resources like printers and high capacity storage devices. They allow users to exchange messages via electronic mail. LANs can also connect to other communications lines or other LANs to give users even more connectivity and flexibility.

LANs are a subset of data communications. As with any data communication system, there are three elements to consider. These elements are architecture, network hardware, and protocols.

LAN Architectures

LAN architectures can take at least four forms — the star, bus, ring, and double ring. These architectures are illustrated in Figure 4-6. A star architecture has a central computer to which all the other workstations

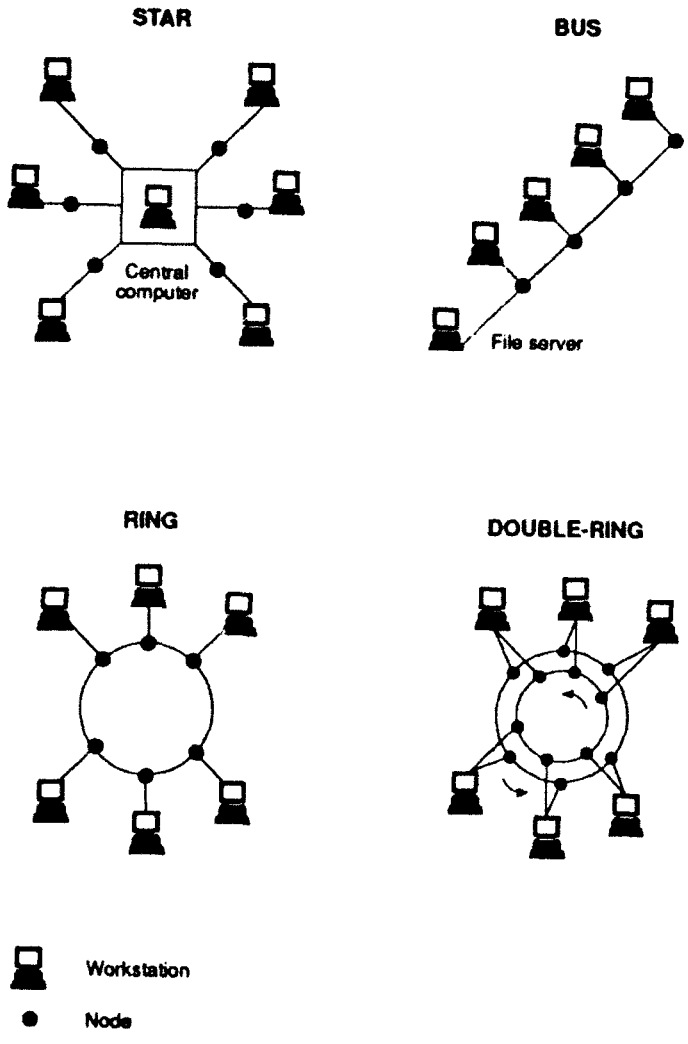


Figure 4-6. LAN Architecture Configurations

connect. An advantage of the star architecture is that control, maintenance and diagnostic functions can be centralized. The disadvantages to this architecture are that the central computer is a single point of failure and multiple cables can build up around the central computer.

A bus architecture is a single data link connecting all of the computers serially. The bus has been likened to a data "highway" (data travels outward in both directions from a computer or workstation) connecting the computers. There is no crowded central area with this scheme and workstation failures will not interfere with network operation. The disadvantage of this configuration is that a single node failure can cause the network to fail. Many low-cost LANs use this architecture. However, the central control and diagnostics are sacrificed with this architecture. Also, workstation nodes on the bus must be greater than some minimum distance because of possible signal interference.

The ring architecture is a ring of nodes. Data generally travels from node to node in only one direction. Ring architectures generally use tokens to control access to the network and are referred to as token-ring architectures. An advantage to a ring topology is that the network can withstand the failure of various workstations by bypassing them. (However, a single node failure can cause the network to fail.) One possible disadvantage to the ring topology is that the entire network must be shut down in order to add a single new node. Solutions to this problem include wire centers that allow connection of computers without shutting down the network. The token-ring architecture is used by the standard IEEE 802.5.

The double ring architecture is two rings of nodes. Data travels in opposite directions on the two rings. A token can be passed along on both rings, effectively doubling the network throughput. The second ring also provides for a backup. In case of node failure on one ring, the other ring would then carry all network traffic. FDDI, also known as ANSI X3.139 and X3.148, uses a double token-ring architecture.

LAN Network Hardware

LAN network hardware encompasses the communication medium and physical interfaces used in the network. The communication medium for LANs can be twisted-pair, coaxial or fiber-optic cable. The connectors will be chosen based on the type of media used in the network. Twisted-pair cable is the least expensive choice of media. Twisted-pair cable consists of two insulated wires twisted together. It comes in a wide variety of sizes and

shielding thicknesses, but one of the most commonly used types is the same wire that is used for telephones in homes and offices. One advantage to twisted-pair wire is that it is inexpensive to use and sometimes existing telephone wire can be used. The disadvantage of twisted-pair wire is that it is limited in transmission speed and distance. Maximum distances for twisted-pair LANs are less than 1000 ft. and if regular telephone wire is used, the maximum distance is only about 330 ft. This media choice is used for small LANs with a limited number of users.

Coaxial cable consists of a center conductor and a surrounding outer conductor with insulation in between. This type of cable is also familiar — it is used in homes as cable television wiring. This wiring is more expensive and not as easy to install as twisted-pair, but makes up for that in terms of increased speed and distance. Coaxial cable can be of either baseband or broadband type. A network using baseband cabling is used for data-only networks and can operate at rates up to 10 Mbps. Baseband cabling makes it easy to tap a new workstation into the network and allows distances on the LAN of about 1500 ft. The commonly used Ethernet and the IEEE standard IEEE 802.3 employ baseband coaxial cable. Broadband cabling can carry several different signals at different frequencies and allow integrated signals composed of voice, data, and video. Broadband cabling has a bandwidth of about 300 MHz. This allows as many as 50 channels each operating at a data rate of 5 Mbps, for example. Broadband cabling is more expensive and involves much more planning and equipment than the other choices of media.

Fiber optic cable offers several advantages over metal cables. Fiber optic cable allows much higher data transmission rates, much longer distances in the network, is immune to electromagnetic interference and is virtually immune to unauthorized reception. Network distances of several miles are possible when using this cabling. One disadvantage to fiber is that it is suited only for point-to-point transmission; broadcasting simultaneously to several workstations from one node is not feasible. Fiber optic cable can be either single mode or multimode fiber. Single mode fiber has a very wide bandwidth, but is difficult to install and requires a more expensive light source than multimode fiber. Multimode fiber allows less expensive light sources and is easier to install. The FDDI standard, ANSI X3.139 and X3.148, uses multimode fiber optic cable.

LAN Protocols

The most common LAN protocols are the IEEE 802 series, Ethernet, and FDDI. These protocols all describe OSI reference model layers one and two. (Protocols for higher layers generally work independently of LAN configurations.) One concern when designing a LAN protocol is how to control workstation access to the network. How does a computer know that the network is quiet and that it may now transmit its message? One method to do this is Carrier Sense Multiple Access with Collision Detection (CSMA/CD). This method was originally used by Ethernet and later by IEEE 802.3, which is modeled on Ethernet. The CSMA/CD method allows the computers or workstations to broadcast a message whenever they do not sense another message on the network. If two workstations release a message at the same time a "collision" occurs. When a collisions occurs, the network detects this and removes both messages from the network. The two computers wait a random time and try again.

Another method to control network access is to use tokens. Tokens are data packets that a computer must receive before it can send a message. A workstation with the token can send a message to another workstation on the LAN. When the message is received, the receiving workstation sends a reply. When a sending workstation receives a reply that its message was received, it passes the token to the next workstation on the network. If a workstation does not need a token at that time, it passes it on down the line. IEEE standards IEEE 802.4, token-passing bus, and 802.5, token-ring, and ANSI X3.139, FDDI, are based on the token method for network access.

USER PROCESSING SUPPORT

User processing support can encompass a wide range of capabilities and products designed to ease the user's interaction with a computer system and help the user derive more meaningful information from automated systems. Two specific, yet very different, categories of user aids are user interfaces with computer systems and decision support applications. Products providing these capabilities can be either commercial software or customized, CINC-unique developments.

User Interfaces

Automated systems and software applications expedite and simplify many tasks within the command center, but they impose on the command center staff member the need to learn, retain, and practice a different method of interacting with each automated tool. Even among applications based on the same operating system, there are significant differences in commands, screens, and operating procedures.

The target architecture calls for a solution to this problem. A unified user interface, in which several programs would respond to an identical basic command set, would help the user move easily and quickly from one application and function to another. A further development of this idea is the concept of integrated software clusters. A cluster of applications could not only present the same screens to the user and respond to the same commands, but also share data across application boundaries. This would enable the user to interact with a wide-ranging database that is organized by topic, rather than application; The user could query the database just once and have the system display all entries matching the query topic – regardless of whether the entries are in text, graphics, or AMHS files. The user could also make a change in one application, such as a database, and see the change reflected automatically in briefing charts and the like.

Despite wide support in the command center community for the development of this type of user aid, commercial efforts in this area are not promising. Since most programs that are likely candidates for inclusion in integrated software clusters are nondevelopmental, commercial ones, and since one characteristic of commercial products is differentiation from competitors' products, there is no strong push in the commercial industry to develop unified interfaces.

Decision Support Applications

Decision support applications help users visualize possibilities and reach decisions. They are by nature interactive. By providing the system with all of the data that bears on an unstructured problem and allowing the system to apply the expertise built into it by its designers, a user can:

- Become more familiar with a problem by analyzing how different factors interrelate
- Examine what impact changes in each variable have on the outcome
- Identify patterns in input data or results
- Predict the outcome of various decisions
- Develop models to guide actions
- Compute optimum employments of effort, personnel, time, or money.

To support these functions, a decision support system must have a powerful statistical capability and a detailed knowledge base to apply to the specific types of problems it was created to assist with. Two types of decision support system, expert systems and artificial intelligence applications, approach problems differently.

The "expert" in an expert system is not the computer, nor the person attempting to solve a problem. The system's knowledge base is provided by an expert in a particular subject, and the system is designed by a computer expert to provide a preset response when a particular set of circumstances is present in the problem posed to the system. In effect, the computer is "standing in" for the actual human expert. Artificial intelligence, on the other hand, is the ability of the application to store information to which it gains access and to use that new information to solve problems. AI applications typically operate on data from several *different* sources, and thus cannot usually be implemented on noninteractive hardware and with nonintegrated software packages. This limitation underscores the need for interconnected information processing utilities.

Because sophisticated decision support systems require extremely large development efforts tailored to the needs of a very small end user group, their actual implementation in the current command center environment is problematic. Increasing definition in the command center system architecture of what common decision support applications are desired may provide an impetus for future developments.

OFFICE AUTOMATION

Currently, most command center information handling processes are manual, and personnel performing them are not able to keep pace with rapidly changing events. Existing systems and facilities have exceeded their capacity and utility, forcing the use of supplementary procedures that can also compli-

cate an operator's task. The principal means for achieving a satisfactory capability for effective information exchange is upgrading through automation. Figure 4-7 illustrates how office automation (and user processing support and automated message handling) is changing command centers at the operator level.

"Office automation" is in one sense a generic term that encompasses parts of several of the capabilities separately distinguished in the command center system architecture, such as briefing preparation and user processing support. A more narrow definition of office automation in the command center context is needed. For the purposes of this document, office automation will be considered to include those tasks that allow traditionally manual or mechanical tasks to be performed with the aid of electronic devices, except where these tasks involve briefing preparation. According to this definition, office automation includes word processing, electronic publishing, graphics preparation (including image scanning), automated scheduling and calendar functions, and personal database management. These capabilities are provided mainly by function-oriented applications that run on generic computer hardware. This discussion principally addresses software, although hardware-software combinations that perform image and text scanning are described in detail in the "yellow pages" at the end of this chapter. Because output devices, though essential to the full utility of these applications, are generally not application-specific, they are discussed as hard-copy generation devices under the "Briefing Preparation" heading.

Word Processing

Word processing automates the typing function and provides a means to store documents electronically. Many word processing applications are commercially available; they range from products aimed at the home and school markets to professional-use packages that push the boundary between word processing and electronic publishing.

There are several criteria that should influence the selection of a word processing application for command center use. The most basic issue is what hardware platform and operating system are in use. There is a range of off-the-shelf choices available to users of DOS-based, Macintosh-based, and Unix systems, and some applications are distributed in different versions for different operating systems.

The intended use of the application must be considered from several perspectives. If the application is a basic utility that everyone will use to some degree, ease of learning and use is important; if it is intended for regular use by a few well-trained personnel, ease is not such an important consideration. In addition, if word-processed output is used in fairly rough form, a complex, high-end word-processing application might be overloaded with functions that would never be used. The preparation of monitoring and analysis reports that are used internally and soon superseded is an example of the sort of task that does not require anything more than a basic office-use word-processing system. If, on the other hand, sophisticated reports with integrated graphics are required, an application with more features would be appropriate. Such applications offer the ability to create multi-columnar formats, to merge graphics with text, to create tables of contents automatically, to define and store predetermined styles for different kinds of text, and other features.

Compatibility between applications is an issue that is especially relevant to the command center environment. The rapid nature of command center operations makes retyping information or performing lengthy conversion processes unacceptable. The ability to transfer information from a word-processing application to a briefing-preparation program or a database should be thoroughly investigated before a word-processing application is selected.

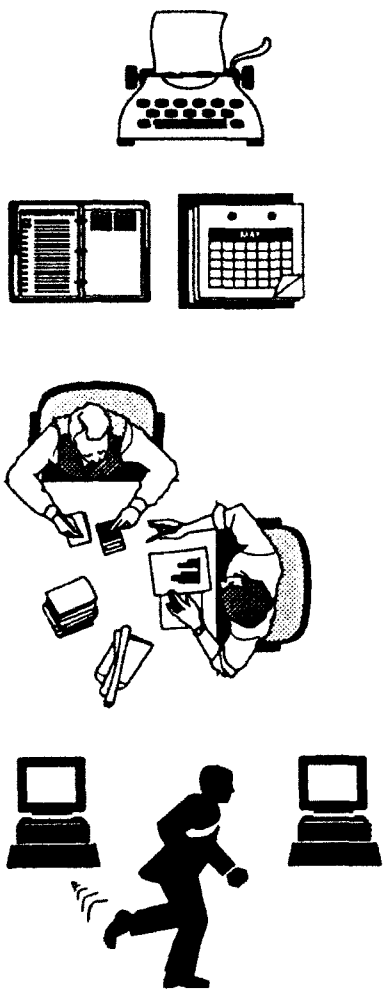
Electronic Publishing

Electronic publishing or desktop publishing (the latter term is becoming obsolete as systems expand beyond the desktop) represents a significant step in capability beyond word processing. In the non-DoD world, electronic publishing applications are used to integrate and manipulate text and graphics in complex ways, to prepare advertisements, newsletters, magazines, and even large books for professional printing, and to drive imagesetting equipment to produce masters or negatives for use in the printing process.

Command center users need few if any of these capabilities. Their uses of an electronic publishing application could include producing formal reports, making briefing charts, and manipulating and integrating photographic images with text. While all these activities are certainly possible with an electronic publishing system, they are not necessarily performed most efficiently using such an application. As noted in the discussion of word processing, many word processing applications provide publishing-like features such as multicolumn capability and style definition; the ease of learning, ease of use, and relative cost of word processing packages makes them a better

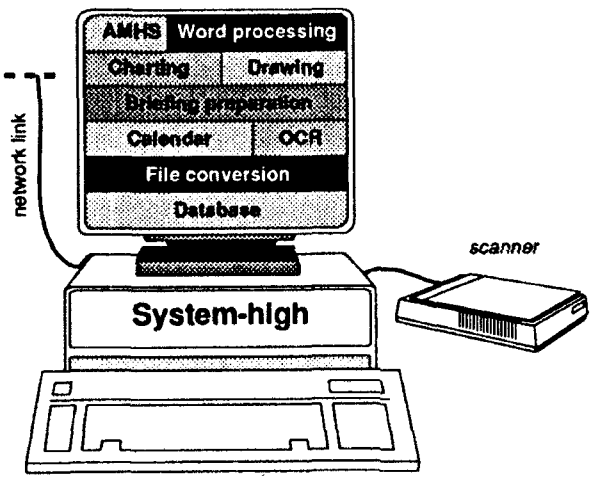
OBSOLETE

- Separate manual processes perform each function
- "Sneaker network"—hand-carrying and re-entering data—links system



CURRENT

- Dissimilar applications address specific needs
- System operates at one security level only
- File conversion and image and text scanning reduce re-entering of data



TARGET

- All applications respond to same commands
- Increased compatibility reduces document scanning and conversion needs
- Some MLS capability allows processing at 2 security levels

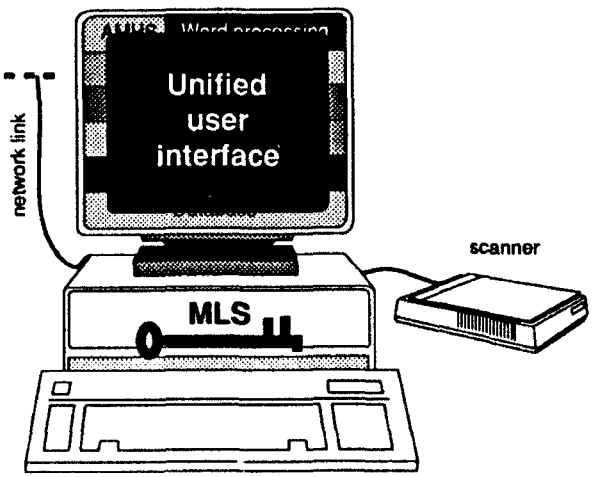


Figure 4-7. Office Automation

choice when the need to produce "published" reports is not constant. Similarly, a number of specialized briefing preparation packages offer all of the capability for creating briefings that an electronic publishing product does, and more. Finally, while electronic publishing products enable the user to manipulate the size and tone of photographs somewhat, even electronic publishing professionals rely on specialized photographic editing products to perform any but the most basic tasks.

Graphics Preparation

Graphics are the visual representation of data. The principal reasons for using graphics in a command center are to effectively present information to a decision maker, and to assist in the analysis of that information in order to facilitate the decision. Analytic graphics allow briefers to illustrate a relationship that may not be clear by looking at data alone. Because data relationships may be the first indicators of problems or opportunities, it can be useful to give them a graphical representation.

Developing a graphic representation of data for briefings is a creative task. A person absorbs certain facts and then visualizes the way in which those facts should be graphically presented. He mentally creates the graphic with no apparent effort. The finished product stands complete in his mind's eye: a clear translation of data into a graphic which is, however, invisible to others.

Between that creative moment and the completed visual result, the task of physically organizing and manipulating data into graphic form and then displaying it tends to complicate the graphic's development process. The more familiar and comfortable the equipment and procedure, the easier the task. This section provides information on graphics creation applications.

Most command centers rely on commercial off-the-shelf graphics products. Various packages are available for the numerous hardware platforms and operating systems in existence. They can be divided into three categories: paint programs, general drawing programs, and specialized graphics programs.

Paint Programs

Paint programs are bitmap graphics applications – that is, they store graphic information as a pattern of pixels. Because bitmaps cannot be edited or resized without a loss in image quality, paint programs are seldom used to produce charts and informational graphics for reports and briefings. Paint products range from basic utilities like MacPaint to very capable packages such as Pixel Paint Professional. The basic packages have little usefulness in the command center environment. The more sophisticated programs can be used for image annotation and for editing photographs and scanned images; however, products targeted more closely at just the annotation function are becoming widely used. (These annotation products are discussed in Part 5, Briefing and Display.)

General Drawing Programs

Under this banner are object-oriented graphics programs such as MacDraw, Harvard Graphics, Adobe Illustrator, and Aldus Freehand. These programs produce vector-based graphics, which define objects with end points rather than pixel patterns, so they do not pose the problems in resizing and editing that bitmapped (paint-type) graphics do. The differences between the two types are shown in Figure 4-8. Drawing programs allow the user to draw and annotate organizational charts, technical illustrations, simple building layouts or rough maps, and other types of informational graphics. Depending on the file formats offered by each program, graphics created in these applications may be incorporated in reports, briefings, or multimedia utilities.

Specialized Graphics Programs

There are several graphics software packages that are intended to produce a specific type of graphic. These applications include charting products and computer-aided-drafting (CAD) and 3-dimensional modeling programs.

Charting applications such as Cricket Graph enable the user to type information in a table format and then produce pictorial representations of the data automatically. Pie charts, bar charts, line charts, and other formats can all be produced from the same data. Some of these applications perform automated calculation of the figures entered into the table and automated updating of the chart when changes are made to the table. Interestingly, various spreadsheet packages now offer automatic chart generation. A person looking to automate the creation of data comparison charts can choose between charting packages that make tables and spreadsheet programs that make charts.

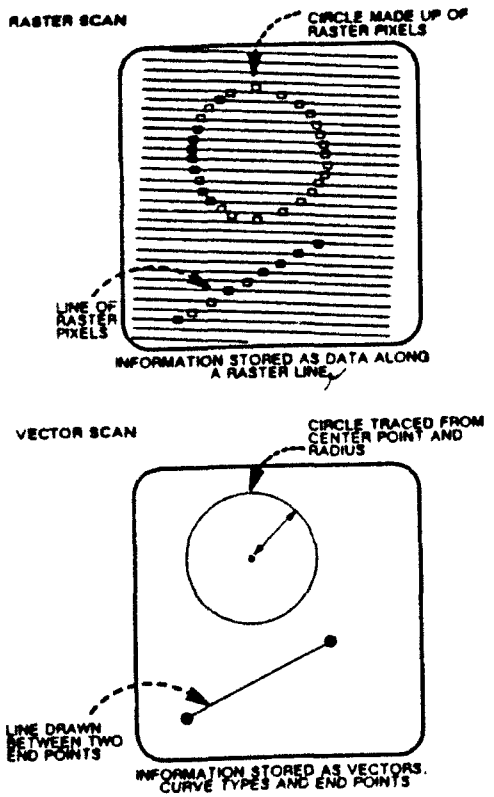


Figure 4-8. Raster Scan and Vector Scan

Three-dimensional and CAD applications are powerful programs with the potential to contribute to operations planning in the command center, but they are not quick-to-learn, common-user tools. Users of these applications usually have to be trained to understand them and the special features they offer. In the command center, these programs can be used to create three-dimensional wire-frame drawings and complex building layouts, including room layouts with furniture icons. Even if they offer limited utility in the operational context, CAD packages provide tremendous benefit to facility modification efforts. They can be used to plan equipment placement, work out cable runs, and identify lines of sight and views from any point within a space.

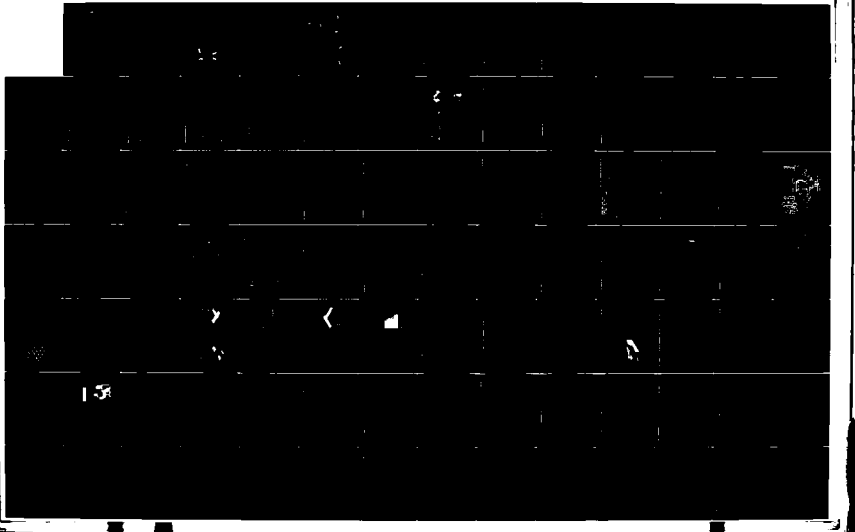
Graphics Application Issues

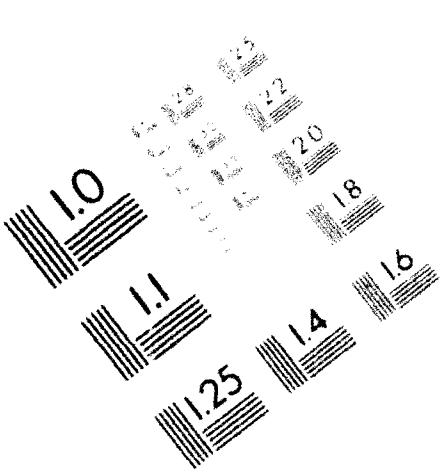
For graphics to be optimally useful within the command center, they need to be integrated automatically with other materials. Different applications, even of the same type, force or allow the user to save graphics in different file formats, including:

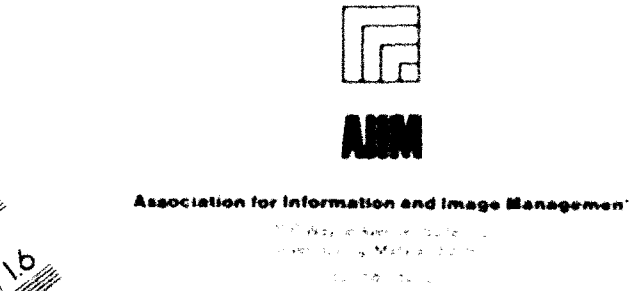
- Bitmaps: As previously mentioned, a bitmap is merely a pattern of pixels. Bitmaps or paint-type illustrations can be transferred into electronic publishing or word processing programs. They can be brought into some of the more sophisticated drawing programs, such as Aldus Freehand, but they are not automatically converted to object-oriented graphics. Usually the bitmap must be redrawn or traced electronically for further refinement within the drawing program. A large amount of clip art is available in bitmap format but, because of resolution problems when bitmaps are resized, its quality is questionable.
- PICT: The PICT and PICT2 formats allow graphics from drawing programs to be saved and subsequently incorporated into text documents, including briefings. Some clip art is available in PICT format.
- Encapsulated Postscript (EPS): EPS is another format for storing drawing-program files. The more sophisticated drawing programs offer the capability to store drawings as EPS files. EPS is very reliable; EPS graphics incorporated into other files experience less distortion of data. Most clip art is sold in EPS format.
- Tagged Image File Format (TIFF): Photographs and some paint-type drawings are commonly stored as TIFFs. Clip-art TIFF collections have recently entered the commercial marketplace.

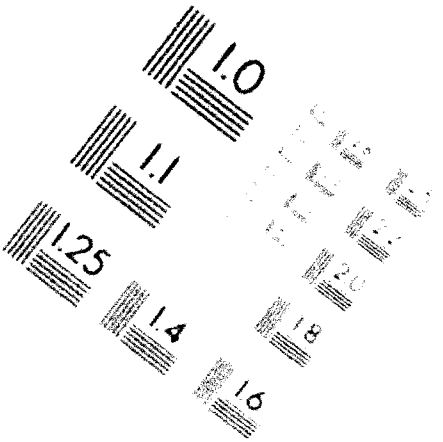
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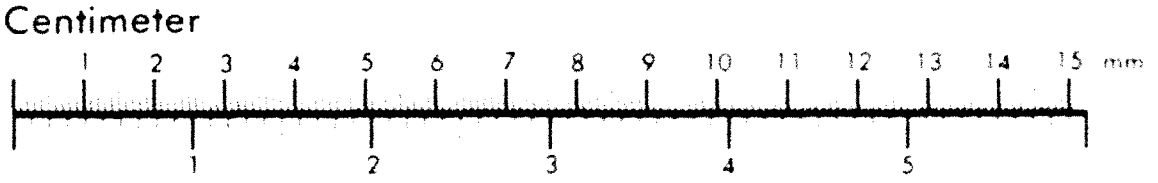
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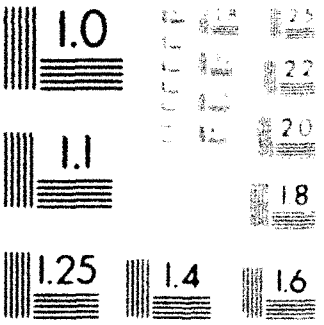


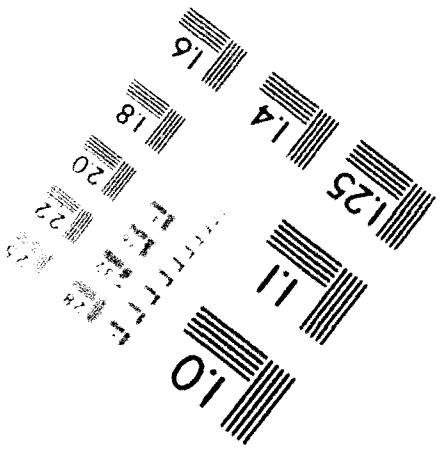


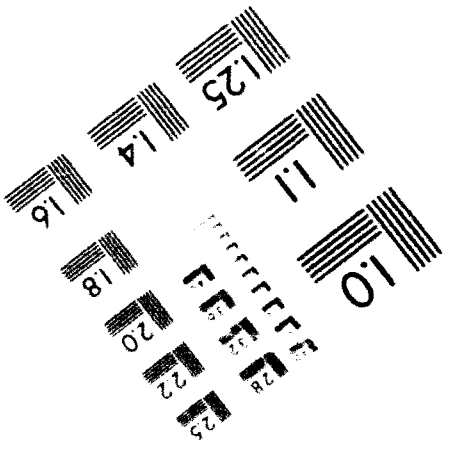












MANUFACTURED TO AIIM STANDARDS
BY APPLIED IMAGE, INC.

Connectivity between applications is, in its way, as important as interoperability between equipment components. The ability to generate artwork quickly by accessing commercial or previously created clip art and adding to it, and the ability to integrate text, photographs, and various types of drawings into a single document that can be printed or displayed, enables command centers to operate much more efficiently.

Scanning

The scanning of text and images represents the easiest way to capture these materials on a computer in cases where files are not compatible or information is not stored electronically. In order to scan text in a machine-readable form that can be subsequently edited, optical character recognition (OCR) software is used. Modern OCR products have the ability to recognize and accommodate multiple columns of text on a page or form layouts; some are also able to "learn" as they work, figuring out unclear words by looking for similar letterforms elsewhere in the document.

Image scanning allows photographs and graphics from unavailable sources to be used on the computer. Scanners on the market today vary widely in quality and features, and include flatbed and hand-held models. Every scanner device must have accompanying software to translate the optically received image into digital format. (Scanners are discussed in detail and several scanning products suitable for command center use are discussed in the DISA publication FACTSHEET 91-1.)

Automatic Scheduling and Calendar Functions

Automated scheduling and calendar functions provide a simple way to declutter a personal work area and organize tasks. Individuals generally adopt these utilities as personal productivity tools, not as a part of a staff-wide upgrade. These tools can provide reminders of appointments and deadlines (often with audible alarms) and perform automatic updating functions, such as updating a changed phone number in all locations where it appears.

Personal Database Applications

Distinct from official command center databases, personal database are another personal productivity tool. They allow users to maintain electronically their files that are not directly related to operations. Points of contact, contractors' deliverable requirements, and computer system configuration data are among the types of information that could be kept in these databases.

DATA MANAGEMENT AND STORAGE

Data within the command center must be managed and stored according to the multiple user levels possible within the facility. Means of rapid recovery of data must be provided, and some centralized control of information must be maintained. A relational data model is a primary tool for data management and storage.

Command center databases vary in size. A large military command center may have up to 500 million characters of diverse data. A single file drawer in the typical manual file system can hold 20 million characters in the form of memorandums, letters, reports, charts, graphs, etc. Therefore, a 500 million character database will occupy six or more four-drawer filing cabinets. This is an enormous amount of data to access manually. The data resource is also dynamic, as indicated in Figure 4-9. This compounds the manual search-and-sort function that operators must perform to understand fully the database file structure and data element composition. Additionally, most command centers have a mixture of automated and manual data resources. This further aggravates the difficulty experienced by operators. Software to extend the capabilities of command center ADP workstations is critical.

Microcomputer vendors claim that software is no problem for ADP workstations, saying that there are hundreds of exceptional software packages available off the shelf at nominal cost. To a degree, that is a true statement. Hundreds of packages are available, including text editing, resource management, database, communications, and graphics. The problem is that many of these software packages cannot operate with each other. Most have their own unique commands (i.e., instruction set) and data formats. The result is that several different types of packages are needed (i.e., text editing, financial, project scheduling, data management, communications, and graphics) in the selection of sufficient and appropriate data elements for incorporation into information summaries. Manual data element selection from such an enormous and varied data source is essentially beyond an operator's capability. It is difficult to be assured that all the relevant data in its most current form has been considered. If the selected data is old and/or incomplete, the resultant summaries can eventually lead to an inappropriate and potentially wrong decision by a commander.

NETWORK MANAGEMENT

Network management encompasses supervisory functions, management of the FDDI backbone network, management of the IPS LAN, overall security management, and the capability for systems recovery.

These functions enable a network manager to monitor, maintain, improve and protect a network. Some of these functions can be automated, some can be simplified by automation, and others must be performed by a human network manager. A network management system is an automated tool to perform some network management functions. The specific network management functions that are needed at a command center depend on its operational requirements; however, these functions can be analyzed according to time-criticality and functional areas.

Time-criticality can be used to divide the types of functions included in network management into three sets. These three function sets are critical, routine, and tactical. Critical functions involve network problems that must be corrected quickly in order to maintain network operation. Rerouting around a faulty link is an example of a critical function. Routine functions those functions that are performed with regularity, but are not as time-critical as critical functions. Monitoring network performance and calculating accounting charges are examples of routine functions. Tactical functions involve long-term planning and analysis of the network. One example of a tactical function is the prediction of future network use and requirements.

The set of network management functions can also be divided into five **functional areas**: performance management, fault management, accounting management, configuration management, and security management. Performance management includes monitoring and measuring normal operations performance; establishing typical utilization figures; monitoring performance for changes from typical utilization; analyzing how to optimize network performance; modifying the network to attain optimal performance; and predicting future network use and requirements.

Fault management consists of the detection, isolation, and correction of abnormal network operation. Included in fault management are monitoring network alarms and states; reviewing network, system, component and line error reports; testing network components; qualifying the nature and severity of the network fault; performing the necessary corrective actions on the fault; tracking network component reliability; constructing and practicing

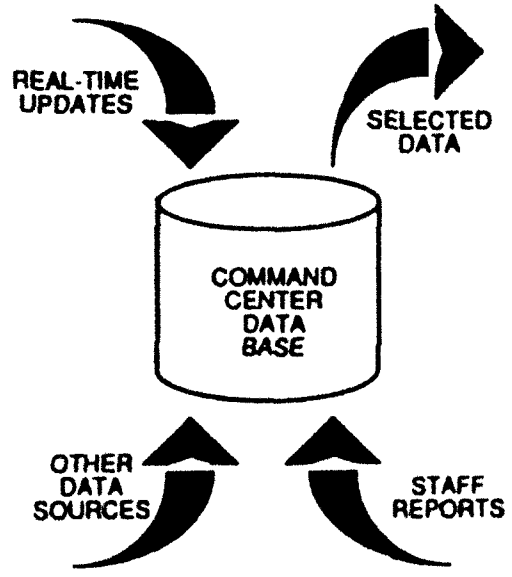


Figure 4-9. Data Resource

disaster recovery plans; and training support personnel in disaster recovery plans.

Accounting management is the calculation of resource charges based on usage. Accounting management includes determining charges for network resources; documenting users' network usage; calculating usage charges; and billing users. Accounting management is an optional function area, but can be useful in maintaining the fair distribution of network resources.

Configuration management is used to maintain the network environment in a controlled, known state. Configuration management includes identifying all logical and physical network resources; monitoring network topology; monitoring and controlling all software and hardware upgrades to the network; and controlling systems' and users' access to the network.

Security management is used to protect the network and its data from unauthorized access or acts.

MAP GRAPHICS

Maps have always been important in the command center environment. Current electronic mapping technology facilitates the use of maps and geographic information. In designing the map graphics portion of an IPS, command center personnel must consider means of map retrieval and display, the use of color graphics overlays, the display of unit information, and the use of various geographic analysis tools.

Electronic mapping systems typically comprise three parts: a software package that runs the system, accompanying data, and hardware that allows mapping information to be entered, stored, displayed, and manipulated. Sometimes the hardware is generic microcomputer and scanner equipment. Similarly, data may come from a source, such as the Defense Mapping Agency, that is distinct from the firm that provides the software.

Within the definition of electronic mapping systems is a spectrum of products. Mapping systems range from simple graphics packages that represent maps as pictures with no geographic relational information, to information systems that support complex relational information processing among features and the presentation of detailed attribute information about those features.

Electronic mapping systems are currently used in command centers as supplements to paper maps. There are both advantages and disadvantages associated with using the systems in a command center. They reduce access time to geographic information and reduce presentation and briefing preparation times when geographic information is used. They provide versatile electronic media for different functional uses such as weather reports, enemy order of battle displays, logistics, mission planning, and intelligence. They support command center intelligence and mission planning and provide the capability for the integration of work electronically based on the same geographic information. They provide the capability to monitor situations in near-real-time, given that near-real-time inputs are available. Layered presentation of data is possible so that unneeded information can be stripped away – a process known as decluttering – to facilitate the efforts of staff depending on geographic information.

Electronic mapping systems have not and perhaps will not ever replace the use of paper mapping products by command center staff, but they do provide applications that support the increased command center requirements for timely and complete information for procession and display to decision makers. Some of the recognized disadvantages of the systems include the staff's greater familiarity with the paper products, the requirement for skilled operators to use the systems, and the need to modify operational procedures to use the mapping information. Space problems are an issue in terms of accommodating the associated mapping equipment. The cost of the equipment, the software, and the mapping data is another consideration. At this time, the systems are not widely suitable for battlefield situations, but the use of electronic mapping systems in the command center environment continues to expand, and as the systems evolve their application will increase.

BRIEFING PREPARATION

Briefings are the typical end-product of many of the functions performed in the command center. Briefings are typically made up of displays having text, graphics, or both, assembled so that a briefer may present an organized story using the briefing aids available. These may include video projectors, screens, audio support, lighting and respective controls, slides, charts, and graphics. For the purpose of this discussion, the concept of briefing preparation is confined to the tasks of slide creation, slide editing, slide ordering, and the provision of hard copies of the briefing. Other aspects of the manipulation

and presentation of briefings are discussed in Part 5, "Briefing and Display Subsystem Standards, Guidance, and Component Information."

The traditional (i.e., non-automated) process of preparing briefing information, as illustrated in Figure 4-10, uses selected data elements to show history, trends, conclusions, and recommendations appropriate for the subject being developed. This data must be correlated, tabularized, compared, and have its form changed for display, probably as a graphic. In addition to possessing the ability to search and sort enormous volumes of data, an operator must have extensive analytic skills and an exceptional ability to reduce data to highly descriptive attention-grabbing concepts, suitable for presentation via displays. In a manual system, concept development must take place hours in advance because the creation of briefing/presentation aids (e.g., slides, transparencies) takes an extensive amount of time.

The decision-making and staff-action functions are represented in Figures 4-11 and 4-12. The information provided by the briefing may be only one of several inputs to the decision maker in the decision process. The decision may be made by the decision maker in the command center immediately following the briefing; action directives are then prepared. Appropriate staff action is also taken by action officers in the command center. On occasion, however, either the decision making and/or the staff-action functions may take place elsewhere in the headquarters complex. This highlights the need for viable communications both internal and external to the command center.

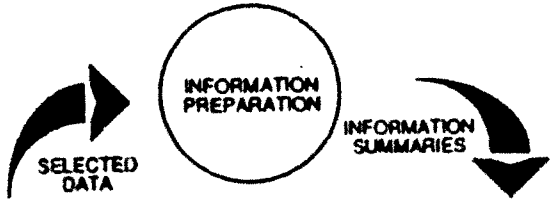


Figure 4-10. Briefing Preparation

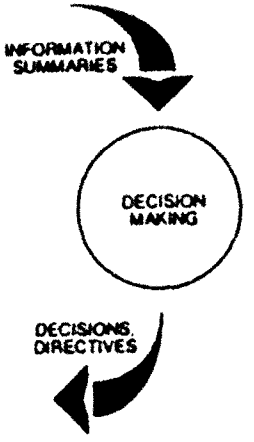


Figure 4-11. Decision Making

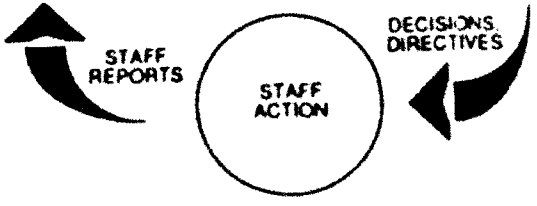


Figure 4-12. Staff Action

Because briefing preparation has traditionally been a time-consuming, manual process involving many people, it is a prime candidate for automation. Typically, parts of the briefing were prepared by several different staff elements in a command center, each contributing from a particular area of specialty (e.g., weather). The information would be gathered and sorted by the command center briefing staff and sequenced in a logical flow. Final script editing would be done by the briefer to fit user's briefing style. Graphics information would be prepared by the graphics staff, typically in the form of viewgraphs or 35 mm slides. The lead time required to make graphics in this manner makes last-minute changes virtually impossible.

Integrated Slide Creation and Editing

Several commercially available products automate the task of creating briefing slides. Two of the most common, Microsoft Powerpoint and Aldus Persuasion, are widely used in command centers. Both provide the capability to type in text for slides, incorporate clip art and graphics prepared elsewhere, and create simple graphics within the application. In addition, Aldus Persuasion and possibly other products allow the complete text of a briefing to be easily imported from a word-processing program. Text may also be created in an internal "outline" window that resembles a word-processing interface and then automatically placed in a predefined format, so that the user can develop and review the content of a briefing completely before giving any thought to format issues. After the briefing is created, slides can be reordered, and speaker's notes can be included on a second electronic copy of the briefing contained within the file. Both Powerpoint and Persuasion enable a briefing to be run directly from the computer terminal; several options allow special-effect transitions from one slide to another, "builds" in which the bullet points on a slide appear one after another, and automatic timing or control via a mouse.

This type of product signals a new era in briefing preparation. For the first time, a briefing can be created and displayed, start to finish, on one machine, using electronic inputs from a variety of sources. In addition, these tools are technically accessible to the authors themselves, and incorporate features such as Persuasion's outline window that accommodate developing ideas at the keyboard. Eliminating the need to carry handwritten drafts to a graphic artist, and subsequently editing and proofreading the work and returning it for refinements, means eliminating the need for a long briefing preparation lead-time.

Color Briefings

With modern technology, it is increasingly possible to use color in briefings. Color not only enhances illustrations and helps to differentiate structure, but also increases the amount of visual information that can be presented at one time. Intelligent application of color assists in highlighting important information.

Individual reactions to color are not equal due to environmental conditioning and attitudes, but certain commonalities exist. In a list of the colors preferred most, blue is first, followed by red, green, violet, brown, orange, pink, turquoise, and gray. Human reactions to color cannot be standardized. However, in a command center viewers will expect colors to have specific customary meanings (e.g., red: warning, danger). These color "codes" should be considered before new applications are attempted.

Certain colors used together can cause three-dimensional effects. This effect must be considered in adjacent color mixing. For example, red parts of an image will appear closer than blue. These effects can be used to give graphics a three-dimensional character. Receding colors (blue and green) are best used for background information. As shown in Figure 4-13, for colors of equal lightness or darkness, the eye is most sensitive to yellow and least sensitive to blue. Research has established the most frequently used combinations: black and white; red and yellow; green and red/pink; yellow and blue.

Hard-Copy Devices

Although briefings are primarily displayed as slides or viewgraphs, there are many occasions when a hard copy of an image or textual graphic is required. The economy and range of types of hard copy devices have grown quickly, with the economy factor partially driven by falling personal computer prices.

- Pen plotters: Pen plotters are a mainstay of hard copy. Their price and performance are very attractive. It is possible to buy pen plotters in the $100/inch-of-width range with plotting speeds of up to 40 inches per second. However, other products are becoming competitive. These include matrix printers and color electrostatic printers. In the past, they were about 20 times as expensive as pen plotters. Recent market developments could cause significant price reductions in electrostatic printers, bringing them into a lower price range.

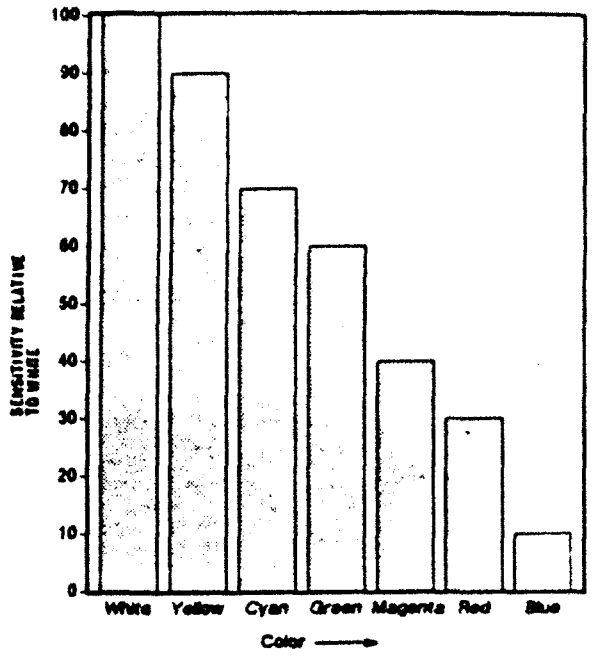


Figure 4-13. Sensitivity of the Eye to Various Colors

- Film-based devices: Film recorders continue to be improved and today it is possible to buy products such as the Matrix PCR and the CALCOMP Samurai which are 2,000- and 4,000-line film recorders selling under $15,000. In addition to these high-quality film recorders, a range of simpler instant film systems are also available. Normally utilizing Polaroid instant film in many sizes, they provide good-quality, fast hard copy from video or computer outputs. Products such as the Polaroid Palette and Type 48 in the $2,000 to $8,000 range are typical.
- Ink jet and thermal printers: Ink jet and thermal dye transfer techniques are becoming increasingly price competitive. Tektronix, for example, has ink jet products ranging from under $1,000 to the $10,000 range, while Seiko, CALCOMP, and Matrix have announced thermal dye transfer systems in the $5-10,000 range.
- Laser printers: Laser plotters are capturing an increasingly large part of the graphic output market, with black-and-white versions being used heavily in the office automation and technical document areas. Color laser printers are just beginning to enter the commercial market.

INFORMATION PROCESSING SUBSYSTEM PRODUCTS, SYSTEMS, AND PROGRAMS

DOD ELECTRONIC MAPPING SYSTEMS/ PROGRAMS

Army Portable All Source Analysis Workstation (PAWS)

product type: Combined software and hardware product

function: Map display and mapping system performs intelligence functions

system description: A system of mapping software with the capability to interface with commercially available non-mapping software (textual database, word processing, automated message handler). Handles raster-based digitized DMA paper product data, digital feature analysis data (DFAD), and digital terrain elevation data (DTED). Can overlay information, has ability to predict time to traverse, shows prior locations of icons, shows frequency ranges, and can perform aircraft mission planning and airspace control. It does not support map creation or alteration.

users: Government users at technician level

command center components: Proprietary ruggedized MicroVax II

acquisition details: Government software is free to Government users. Commercial software, ruggedized hardware is $200,000, less if rugged version not required.

future growth: Tempest certification

reference: Engineer Topographic Laboratory, Fort Belvoir, VA

COMMERCIAL ELECTRONIC MAPPING SYSTEMS/ COMPONENTS

Interactive Television Company (ITC) Fulcrum

product type: Hardware/software combined product

function: This map display and mapping system uses digital data and analog information

system description: This product uses analog DMA video discs, supplemented by digital data. The digital data is manipulated to perform various digital calculations but is not integrated with the analog map data. The digital data is related to the analog map data by latitude and longitude and can overlay information onto the maps. Additionally, a digital gazeteer provides place names and locations on the maps and can be amended by the user by adding names and places to the gazeteer.

users: Government technicians/high-end commercial users.

command center components: Workstation PC (IBM compatible, Apollo, PC DOS, SUN, or Apple Macintosh), RGB monitor, video disc player, and software

acquisition details: Hardware: PC, monitor video disc player, cables, graphics card $7,250; software $3,270.

future growth: ITC plans to support DMA digital products as they become available.

reference: Interactive Television Company, 1800 N. Kent Street, Suite 920, Arlington, VA 22209

Geodynamics Map Scanning Station (MSS) and ToolKit

product type: Hardware/software combined mapping system

function: Mapping and display system that scans, processes, manipulates, and displays mapping information; map digitization, display, mapping system.

system description: Scans and preprocess paper MC&G products and manipulates and displays raster and rector mapping data. Can display composite information, flicker between two views of an identified area, perform color separation when scanning color maps, allow for clutter/ decluttering and layering of data. Customizing of software required.

users: Technician; government/high-end commercial users.

command center components: Raster scanner, SUN (SUN, PC, or other Unix-based machine) workstation, two display units.

acquisition details: Software plus basic hardware listed above, $$220,000.

future growth: N/A

reference: Geodynamic Corporation, 304 Inverness Way South, Suite 300, Englewood, CO 80112

Lockheed Softcopy Map Display System (SM) and User Interface System (LUIS)

product type: Mapping software modules

function: This mapping and display product displays and customizes mapping information and supports rapid prototyping and user interaction for software evaluation and training purposes.

system description: Two software modules are designed to display map information and customize and alter it graphically. User-interface design package supports rapid prototyping, customizing, interfacing of other software, and user interaction analysis for software evaluation and training applications. The product provides capability to overlay, declutter at varying scales, zoom between scales, and display prior locations of icons. With additional government-owned software, user can perform satellite applications mapping.

users: Technicians; government/high-end commercial users

command center components: Apollo, SUN, MicroVax, or other Unix-based machine

acquisition details: Total system is $50,000 (SMS $37,000, LUIS $13,500). Cost to customize software is additional.

future growth: N/A

reference: Lockheed Missiles and Space Company, Inc., 6800 Burleson Road, Austin, TX 78744

Intergraph Topologically Integrated Geographic and Resource Information System (TIGRIS)

product type: Software and hardware combined

function: This system provides cartographic and database functions: mapping, imaging, analysis, and modeling.

system description: System consists of four software modules. Mapping module digitizes vector information from paper maps and photos and can make modifications to the information. The imaging module is a full range image processing system: input, manipulation, and conversion of raster and vector data. The analyst module performs spatial queries and analysis on digitized maps. The modeler does two- and three-dimensional terrain modeling.

users: Technicians; government and high-end commercial users

command center components: Unix-based workstation (proprietary) including screen, keyboard, mouse

acquisition details: Hardware is $27,000. Software: Analyst $10,000, Mapper $5,000, Imager $20,000, Modeler $10,000

future growth: N/A

reference: Intergraph Corporation, Federal Systems Division, 2051 Mercator Drive, Reston, VA 22091

COMMERCIAL OPTICAL SCANNING SYSTEMS/ COMPONENTS

Calera CDP9000 Compound Document Processor

product type: Hardware image/text scanner device coupled with OCR software

function: This product provides optical character recognition and bi-level image scanning for document storage and retrieval systems.

system description: The CDP9000 is a complete document processor that uses proprietary recognition algorithms to convert scanned text and image data to ASCII and bit-mapped image files. An automatic document sheetfeeder allows up to 50 sheets to be processed at a time. The CDP9000 reads a variety of typewritten and typeset documents and can perform omnifont character recognition at up to 250 characters per second in a single pass. Host software is available for MS-DOS, Macintosh, and UNIX environments, and the CDP9000 can be networked. Features include batch processing, ability to read double-sided documents, user selective areas for OCR to take place (zoning), and page job separating ability.

users: Personnel should be familiar with personal computers and have word-processing skills. This is not a home market product; it caters to the professional office environment.

command center components: Self-contained desktop unit which includes a document feed tray. The unit connects to a PC with an interface cable and software and is loaded with Calera's TopScan Professional recognition software.

acquisition details: The CDP9000 bundled with TopScan Professional OCR software is $31,950 (pricing as of May 1991).

future growth: The CDP9000 is one of the leading OCR systems and is a well developed product. TopScan Professional AT software/processor board combination to support third party scanners has just been made available and is $6,495 (May 1991).

references: Calera Recognition Systems. Inc., 2500 Augustine Drive, Santa Clara, CA 95054, (408) 986-8006. See DISA *FACTSHEET 91-1: Optical Scanning Systems: A Technology Survey* for further reference.

Xerox Datacopy GS-Plus Grayscale Scanner with Gray F/X Software

product type: Hardware grayscale image scanner device coupled with image editing software

function: This product will digitize black and white photographs, maps, etc. to create image databases for desktop publishing or briefing and requirements

system description: The Xerox Datacopy GS-plus flatbed scanner has a moving scan head assembly and will scan up to a 8.5 by 14 inch document. The Datacopy GS-plus operates as an 8-bit grayscale scanner, but also functions as a bi-level image scanner with selectable scan resolutions from 75 to 300 dpi in 1 dpi increments. Gray F/X raster editing software, also from Xerox, provides 6-bit grayscale image editing and manipulation capability. Standard image mapping operations such as brightness and contrast control allow for interactive correction of poor quality source images.

users: Personnel should be familiar with personal computers and have a working knowledge of image scanning and image editing skills.

command center components: The Datacopy GS-plus is a self-contained desktop unit which may include an optional document feed tray. The unit connects to a PC with an interface cable; GRAY F/X image editing software package would be loaded on the host PC and controlled with a mouse.

acquisition details: Datacopy GS-plus scanner bundled with Gray F/X software was priced at $2,195. Sheetfeed attachment option is $595 (May 1991).

future growth: The Datacopy GS-plus scanner will support many new image editing software packages. Xerox may eventually unveil a similar machine to handle color information, as well as support OCR software packages.

reference: Xerox Imaging Systems, 185 Albany St., Cambridge, MA 02139, (800) 248-6550. See DISA *FACTSHEET 91-1: Optical Scanning Systems: A Technology Survey* for further reference.

Intergraph 1140C Flatbed Color Scanner System with Editing Software Tools

product type: High-resolution grayscale image scanner and host workstation bundled with controlling and image editing software

function: This scanner system digitizes grayscale or black and white graphical data such as photographs, maps, schematics, etc. to be edited and stored in a computer system. The system allows for the creation of image databases for desktop publishing and briefing and display functions.

system description: The Intergraph Eagle 1760 Scanner is a flatbed, dual CCD array, high-resolution desktop scanner that incorporates Intergraph's I/SCAN and I/RAS 32 interfacing and raster image editing software packages. The 1760 accepts documents up to C-size and mounted media up to a half-inch thick. The unit operates under the UNIX environment and interfaces with Intergraph Clipper RISC-based workstation packages. The unit is a grayscale and line art scanner. I/RAS 32 image edit software offers a set of cleanup and editing tools to help render quality raster images from the scan process.

users: The 1140C system is aimed at the government and high-end commercial publishing market. The system should be operated by skilled technical personnel. The system provides numerous capabilities, some of which are quite complex, requiring technical/artistic skill to master.

command center components: Workstation configuration can vary and is generally comprised of a floor standing (tower) main host processor, 19" monitor, mouse, and the desktop scanner. System control and image edit software resides in the host workstation.

acquisition details: Complete Eagle 1760 scanning system as evaluated is $53,400. Separate pricing breakdown is: complete Series 2000 turnkey host workstation with 19" monitor used to control the scanner $15,900; I/SCAN interfacing software $5,000; I/RAS raster edit software $2,500.

future growth: Increased processing speed incorporated into future workstation products is expected. Additional image editing software enhancements will be incorporated as future software updates are released.

reference: Intergraph Corporation, One Madison Industrial Park, Huntsville, AL 35807-4201, (800) 826-3515. See DISA *FACTSHEET 91-1: Optical Scanning Systems: A Technology Survey* for further reference.

Kurzweil K5200 Intelligent Scanning System

product type: Hardware text/image scanner device coupled with OCR software

function: This product provides optical character recognition, bi-level, and grayscale image scanning for document storage and retrieval systems.

system description: The Kurzweil K5200 Intelligent Scanning System from Xerox Imaging Systems is a sheetfed compound document processor that features a RISC-based (reduced instruction set computing) intelligent character recognition (ICR) processing unit. The K5200 incorporates exclusive artificial intelligence-based processing that provides high overall character recognition over a wide range of documents, and increased speed of the character recognition process. The unit can scan black and white halftone, line art, and 16 to 256 level (4 to 8-bit) grayscale images up to 8.5 by 14 inches in size. Operating under the Windows 3.0 environment, an interactive Text Verifier allows questionable characters to be learned by the K5200. The system will perform batch processing and supports over 20 word processing formats as well as 10 foreign languages.

users: Personnel should be familiar with personal computers and have well developed word-processing skills.

command center components: The K5200 is a self-contained desktop unit which includes a document feed tray. The unit connects to a PC with an interface cable and software controlled with a mouse. Running under Windows 3.0, Xerox's OCR software resides in the host PC. An external mass storage device such as an optical drive system is recommended as additional hardware.

acquisition details: The Complete turnkey K5200 system is $19,755 (GSA) (priced May 1991).

future growth: The K520 is the current leader in trainable OCR systems. The company's future developments will center around their unique Artificial Intelligence-based approach to text recognition software. A CALS compliant system will become available.

reference: Xerox Imaging Systems, 185 Albany St., Cambridge, MA 02139, (800) 248-6550. See DISA *FACTSHEET 91-1: Optical Scanning Systems: A Technology Survey* for further reference.

Sharp JX-450 and JX-600-Series Color Scanners

product type: Desktop color image scanning device bundled with scanner interface control software

function: This system will digitize color photographs, maps, etc. to create image databases for electronic publishing or briefing requirements.

system description: The Sharp JX-series Color Scanners are single CCD array, fixed scan head assembly flatbed scanners that offer continuous-tone and line art scan modes. The JX-450 detects data at 256 shades of red, green, and blue (8-bit) color out of a color palette of 16.7 million colors. The scanner also detects 8-bit continuous-tone images at 300 dpi scanning resolution. The JX-600 detects data at 1024 gradation level shades of red, green, and blue (10-bit) color, and 8-bit continuous tone images at 300 dpi scanning resolution. An internal GPIB (IEEE-488) parallel interface allows control of the JX-series scanners from IBM PC/AT and compatibles, Macintosh, Sun, and Silicon Graphics host computers. Scan area size is 11 5/8 by 17 inches, and 9 alternative image sizes, such as invoice, legal, and letter, are offered. The JX-600 has an additional detachable lamp unit for transparency scanning. ChromaScan scanner interface software for the Macintosh comes bundled with the JX-series scanners. Features include preview scan, dither and sharpness control, brightness and contrast adjust, and RGB color correction.

users: Personnel should be familiar with personal computers and have a working knowledge of image scanning and image editing skills.

command center components: The JX-series of color scanners are self-contained desktop units that interface with Apple Macintosh or IBM computers. An optional transparency attachment for the JX-450 is available. The scanner connects to a host computer with interface cabling and software and operates under control of a mouse. Additional third-party color image editing software is required

acquisition details: JX-450 with ChromaScan software is $3,986. JX-600 version is $9,746. CX-500T1 transparency unit (optional for JX-450) is $385. GPIB interface for MAC II (required) is $404. All products are on GSA schedule (May 1991).

future growth: A lower resolution unit, the JX-300 is currently available An optical disk drive unit developed by Sharp to provide more external mass storage capability will become available. Many third-party software developments will continue to evolve to support Sharp's product line of scanners.

reference: Sharp Electronics Corporation, Sharp Plaza, Mahwah, NJ 07430, (201) 529-8200.

Sony UY-T55 Color Video Scanner

product type: Stand-alone, hardware-only, portable color image-to-video scanning device

function: This device converts flat color and black and white photographs, maps, etc. into video signal information to supplement briefing and display, information processing, and video teleconferencing system requirements.

system description: The Sony UY-T55 color video scanner is a portable flatbed, linear CCD, moving scan head device that provides quick and easy conversion of flat images into video images. The scanner will process up to an A4 size black and white or color document. The unit will fully display a landscape image and allow a portrait image to be scrolled from top to bottom (scroll mode). The video output signal from the UY-T55 can be externally synchronized to other video equipment and includes EIA standard NTSC composite, analog RGB plus sync, and Y/C separated 500 line (S-VHS) video outputs. There are 14 post-scan magnification levels, cropping, as well as contrast, sharpness, hue, color, and brightness picture quality controls. Scan modes include normal, fine, black and white, and title mode, which allows for a second image to be scanned and superimposed onto the source image.

users: The device is extremely simple for the common user to operate. This is a commercially available product catering to the professional briefing creation and presentation environment.

command center components: The UY-T55 is a portable tabletop device requiring no external computer or software to operate. Depending on user requirements, the unit can interface with a variety of NTSC or RGB video equipment such as video monitors and printers, video projectors, VCRs, as well as computer-based frame grabber image acquisition systems.

acquisition details: The Sony UY-T55 unit is $5,100 on GSA schedule (pricing as of May 1991).

future growth: The ability to store a scanned image(s) internally is an area of potential development.

reference: Sony Corporation of America, Sony Drive, Park Ridge, NJ 07656, (800) 877-7669. See DISA *FACTSHEET 91-1: Optical Scanning Systems: A Technology Survey* for further reference.

INFORMATION PROCESSING SUBSYSTEM PRODUCTS, SYSTEMS, AND PROGRAMS

DOD ELECTRONIC MAPPING SYSTEMS/ PROGRAMS

Army Portable All Source Analysis Workstation (PAWS)

product type: Combined software and hardware product

function: Map display and mapping system performs intelligence functions

system description: A system of mapping software with the capability to interface with commercially available non-mapping software (textual database, word processing, automated message handler). Handles raster-based digitized DMA paper product data, digital feature analysis data (DFAD), and digital terrain elevation data (DTED). Can overlay information, has ability to predict time to traverse, shows prior locations of icons, shows frequency ranges, and can perform aircraft mission planning and airspace control. It does not support map creation or alteration.

users: Government users at technician level

command center components: Proprietary ruggedized MicroVax II

acquisition details: Government software is free to Government users. Commercial software, ruggedized hardware is $200,000, less if rugged version not required.

future growth: Tempest certification

reference: Engineer Topographic Laboratory, Fort Belvoir, VA

COMMERCIAL ELECTRONIC MAPPING SYSTEMS/ COMPONENTS

Interactive Television Company (ITC) Fulcrum

product type: Hardware/software combined product

function: This map display and mapping system uses digital data and analog information

system description: This product uses analog DMA video discs, supplemented by digital data. The digital data is manipulated to perform various digital calculations but is not integrated with the analog map data. The digital data is related to the analog map data by latitude and longitude and can overlay information onto the maps. Additionally, a digital gazeteer provides place names and locations on the maps and can be amended by the user by adding names and places to the gazeteer.

users: Government technicians/high-end commercial users.

command center components: Workstation PC (IBM compatible, Apollo, PC DOS, SUN, or Apple Macintosh), RGB monitor, video disc player, and *software*

acquisition details: Hardware: PC, monitor video disc player, cables, graphics card $7,250; software $3,270.

future growth: ITC plans to support DMA digital products as they become available.

reference: Interactive Television Company, 1800 N. Kent Street, Suite 920, Arlington, VA 22209

Geodynamics Map Scanning Station (MSS) and ToolKit

product type: Hardware/software combined mapping system

function: Mapping and display system that scans, processes, manipulates, and displays mapping information; map digitization, display, mapping system.

system description: Scans and preprocess paper MC&G products and manipulates and displays raster and rector mapping data. Can display composite information, flicker between two views of an identified area, perform color separation when scanning color maps, allow for clutter/decluttering and layering of data. Customizing of software required.

users: Technician; government/high-end commercial users.

command center components: Raster scanner, SUN (SUN, PC, or other Unix-based machine) workstation, two display units.

acquisition details: Software plus basic hardware listed above, $$220,000.

future growth: N/A

reference: Geodynamic Corporation, 304 Inverness Way South, Suite 300, Englewood, CO 80112

Lockheed Softcopy Map Display System (SM) and User Interface System (LUIS)

product type: Mapping software modules

function: This mapping and display product displays and customizes mapping information and supports rapid prototyping and user interaction for software evaluation and training purposes.

system description: Two software modules are designed to display map information and customize and alter it graphically. User-interface design package supports rapid prototyping, customizing, interfacing of other software, and user interaction analysis for software evaluation and training applications. The product provides capability to overlay, declutter at varying scales, zoom between scales, and display prior locations of icons. With additional government-owned software, user can perform satellite applications mapping.

users: Technicians; government/high-end commercial users

command center components: Apollo, SUN, MicroVax, or other Unix-based machine

acquisition details: Total system is $50,000 (SMS $37,000, LUIS $13,500). Cost to customize software is additional.

future growth: N/A

reference: Lockheed Missiles and Space Company, Inc., 6800 Burleson Road, Austin, TX 78744

Intergraph Topologically Integrated Geographic and Resource Information System (TIGRIS)

product type: Software and hardware combined

function: This system provides cartographic and database functions: mapping, imaging, analysis, and modeling.

system description: System consists of four software modules. Mapping module digitizes vector information from paper maps and photos and can make modifications to the information. The imaging module is a full range image processing system: input, manipulation, and conversion of raster and vector data. The analyst module performs spatial queries and analysis on digitized maps. The modeler does two- and three-dimensional terrain modeling.

users: Technicians; government and high-end commercial users

command center components: Unix-based workstation (proprietary) including screen, keyboard, mouse

acquisition details: Hardware is $27,000. Software: Analyst $10,000, Mapper $5,000, Imager $20,000, Modeler $10,000

future growth: N/A

reference: Intergraph Corporation, Federal Systems Division, 2051 Mercator Drive, Reston, VA 22091

COMMERCIAL OPTICAL SCANNING SYSTEMS/ COMPONENTS

Calera CDP9000 Compound Document Processor

product type: Hardware image/text scanner device coupled with OCR software

function: This product provides optical character recognition and bi-level image scanning for document storage and retrieval systems.

system description: The CDP9000 is a complete document processor that uses proprietary recognition algorithms to convert scanned text and image data to ASCII and bit-mapped image files. An automatic document sheetfeeder allows up to 50 sheets to be processed at a time. The CDP9000 reads a variety of typewritten and typeset documents and can perform omnifont character recognition at up to 250 characters per second in a single pass. Host software is available for MS-DOS, Macintosh, and UNIX environments, and the CDP9000 can be networked. Features include batch processing, ability to read double-sided documents, user selective areas for OCR to take place (zoning), and page job separating ability.

users: Personnel should be familiar with personal computers and have word-processing skills. This is not a home market product; it caters to the professional office environment.

command center components: Self-contained desktop unit which includes a document feed tray. The unit connects to a PC with an interface cable and software and is loaded with Calera's TopScan Professional recognition software.

acquisition details: The CDP9000 bundled with TopScan Professional OCR software is $31,950 (pricing as of May 1991).

future growth: The CDP9000 is one of the leading OCR systems and is a well developed product. TopScan Professional AT software/processor board combination to support third party scanners has just been made available and is $6,495 (May 1991).

references: Calera Recognition Systems. Inc., 2500 Augustine Drive, Santa Clara, CA 95054, (408) 986-8006. See DISA *FACTSHEET 91-1: Optical Scanning Systems: A Technology Survey* for further reference.

Xerox Datacopy GS-Plus Grayscale Scanner with Gray F/X Software

product type: Hardware grayscale image scanner device coupled with image editing software

function: This product will digitize black and white photographs, maps, etc. to create image databases for desktop publishing or briefing and requirements

system description: The Xerox Datacopy GS-plus flatbed scanner has a moving scan head assembly and will scan up to a 8.5 by 14 inch document. The Datacopy GS-plus operates as an 8-bit grayscale scanner, but also functions as a bi-level image scanner with selectable scan resolutions from 75 to 300 dpi in 1 dpi increments. Gray F/X raster editing software, also from Xerox, provides 6-bit grayscale image editing and manipulation capability. Standard image mapping operations such as brightness and contrast control allow for interactive correction of poor quality source images.

users: Personnel should be familiar with personal computers and have a working knowledge of image scanning and image editing skills.

command center components: The Datacopy GS-plus is a self-contained desktop unit which may include an optional document feed tray. The unit connects to a PC with an interface cable; GRAY F/X image editing software package would be loaded on the host PC and controlled with a mouse.

acquisition details: Datacopy GS-plus scanner bundled with Gray F/X software was priced at $2,195. Sheetfeed attachment option is $595 (May 1991).

future growth: The Datacopy GS-plus scanner will support many new image editing software packages. Xerox may eventually unveil a similar machine to handle color information, as well as support OCR software packages.

reference: Xerox Imaging Systems, 185 Albany St., Cambridge, MA 02139, (800) 248-6550. See DISA *FACTSHEET 91-1: Optical Scanning Systems: A Technology Survey* for further reference.

Intergraph 1140C Flatbed Color Scanner System with Editing Software Tools

product type: High-resolution grayscale image scanner and host workstation bundled with controlling and image editing software

function: This scanner system digitizes grayscale or black and white graphical data such as photographs, maps, schematics, etc. to be edited and stored in a computer system. The system allows for the creation of image databases for desktop publishing and briefing and display functions.

system description: The Intergraph Eagle 1760 Scanner is a flatbed, dual CCD array, high-resolution desktop scanner that incorporates Intergraph's I/SCAN and I/RAS 32 interfacing and raster image editing software packages. The 1760 accepts documents up to C-size and mounted media up to a half-inch thick. The unit operates under the UNIX environment and interfaces with Intergraph Clipper RISC-based workstation packages. The unit is a grayscale and line art scanner. I/RAS 32 image edit software offers a set of cleanup and editing tools to help render quality raster images from the scan process.

users: The 1140C system is aimed at the government and high-end commercial publishing market. The system should be operated by skilled technical personnel. The system provides numerous capabilities, some of which are quite complex, requiring technical/artistic skill to master.

command center components: Workstation configuration can vary and is generally comprised of a floor standing (tower) main host processor, 19" monitor, mouse, and the desktop scanner. System control and image edit software resides in the host workstation.

acquisition details: Complete Eagle 1760 scanning system as evaluated is $53,400. Separate pricing breakdown is: complete Series 2000 turnkey host workstation with 19" monitor used to control the scanner $15,900; I/SCAN interfacing software $5,000; I/RAS raster edit software $2,500.

future growth: Increased processing speed incorporated into future workstation products is expected. Additional image editing software enhancements will be incorporated as future software updates are released.

reference: Intergraph Corporation, One Madison Industrial Park, Huntsville, AL 35807-4201, (800) 826-3515. See DISA *FACTSHEET 91-1: Optical Scanning Systems: A Technology Survey* for further reference.

Kurzweil K5200 Intelligent Scanning System

product type: Hardware text/image scanner device coupled with OCR software

function: This product provides optical character recognition, bi-level, and grayscale image scanning for document storage and retrieval systems.

system description: The Kurzweil K5200 Intelligent Scanning System from Xerox Imaging Systems is a sheetfed compound document processor that features a RISC-based (reduced instruction set computing) intelligent character recognition (ICR) processing unit. The K5200 incorporates exclusive artificial intelligence-based processing that provides high overall character recognition over a wide range of documents, and increased speed of the character recognition process. The unit can scan black and white halftone, line art, and 16 to 256 level (4 to 8-bit) grayscale images up to 8.5 by 14 inches in size. Operating under the Windows 3.0 environment, an interactive Text Verifier allows questionable characters to be learned by the K5200. The system will perform batch processing and supports over 20 word processing formats as well as 10 foreign languages.

users: Personnel should be familiar with personal computers and have well developed word-processing skills.

command center components: The K5200 is a self-contained desktop unit which includes a document feed tray. The unit connects to a PC with an interface cable and software controlled with a mouse. Running under Windows 3.0, Xerox's OCR software resides in the host PC. An external mass storage device such as an optical drive system is recommended as additional hardware.

acquisition details: The Complete turnkey K5200 system is $19,755 (GSA) (priced May 1991).

future growth: The K520 is the current leader in trainable OCR systems. The company's future developments will center around their unique Artificial Intelligence-based approach to text recognition software. A CALS compliant system will become available.

reference: Xerox Imaging Systems, 185 Albany St., Cambridge, MA 02139, (800) 248-6550. See DISA *FACTSHEET 91-1: Optical Scanning Systems: A Technology Survey* for further reference.

Sharp JX-450 and JX-600-Series Color Scanners

product type: Desktop color image scanning device bundled with scanner interface control software

function: This system will digitize color photographs, maps, etc. to create image databases for electronic publishing or briefing requirements.

system description: The Sharp JX-series Color Scanners are single CCD array, fixed scan head assembly flatbed scanners that offer continuous-tone and line art scan modes. The JX-450 detects data at 256 shades of red, green, and blue (8-bit) color out of a color palette of 16.7 million colors. The scanner also detects 8-bit continuous-tone images at 300 dpi scanning resolution. The JX-600 detects data at 1024 gradation level shades of red, green, and blue (10-bit) color, and 8-bit continuous tone images at 300 dpi scanning resolution. An internal GPIB (IEEE-488) parallel interface allows control of the JX-series scanners from IBM PC/AT and compatibles, Macintosh, Sun, and Silicon Graphics host computers. Scan area size is 11 5/8 by 17 inches, and 9 alternative image sizes, such as invoice, legal, and letter, are offered. The JX-600 has an additional detachable lamp unit for transparency scanning. ChromaScan scanner interface software for the Macintosh comes bundled with the JX-series scanners. Features include preview scan, dither and sharpness control, brightness and contrast adjust, and RGB color correction.

users: Personnel should be familiar with personal computers and have a working knowledge of image scanning and image editing skills.

command center components: The JX-series of color scanners are self-contained desktop units that interface with Apple Macintosh or IBM computers. An optional transparency attachment for the JX-450 is available. The scanner connects to a host computer with interface cabling and software and operates under control of a mouse. Additional third-party color image editing software is required

acquisition details: JX-450 with ChromaScan software is $3,986. JX-600 version is $9,746. CX-500T1 transparency unit (optional for JX-450) is $385. GPIB interface for MAC II (required) is $404. All products are on GSA schedule (May 1991).

future growth: A lower resolution unit, the JX-300 is currently available An optical disk drive unit developed by Sharp to provide more external mass storage capability will become available. Many third-party software developments will continue to evolve to support Sharp's product line of scanners.

reference: Sharp Electronics Corporation, Sharp Plaza, Mahwah, NJ 07430, (201) 529-8200.

Sony UY-T55 Color Video Scanner

product type: Stand-alone, hardware-only, portable color image-to-video scanning device

function: This device converts flat color and black and white photographs, maps, etc. into video signal information to supplement briefing and display, information processing, and video teleconferencing system requirements.

system description: The Sony UY-T55 color video scanner is a portable flatbed, linear CCD, moving scan head device that provides quick and easy conversion of flat images into video images. The scanner will process up to an A4 size black and white or color document. The unit will fully display a landscape image and allow a portrait image to be scrolled from top to bottom (scroll mode). The video output signal from the UY-T55 can be externally synchronized to other video equipment and includes EIA standard NTSC composite, analog RGB plus sync, and Y/C separated 500 line (S-VHS) video outputs. There are 14 post-scan magnification levels, cropping, as well as contrast, sharpness, hue, color, and brightness picture quality controls. Scan modes include normal, fine, black and white, and title mode, which allows for a second image to be scanned and superimposed onto the source image.

users: The device is extremely simple for the common user to operate. This is a commercially available product catering to the professional briefing creation and presentation environment.

command center components: The UY-T55 is a portable tabletop device requiring no external computer or software to operate. Depending on user requirements, the unit can interface with a variety of NTSC or RGB video equipment such as video monitors and printers, video projectors, VCRs, as well as computer-based frame grabber image acquisition systems.

acquisition details: The Sony UY-T55 unit is $5,100 on GSA schedule (pricing as of May 1991).

future growth: The ability to store a scanned image(s) internally is an area of potential development.

reference: Sony Corporation of America, Sony Drive, Park Ridge, NJ 07656, (800) 877-7669. See DISA *FACTSHEET 91-1: Optical Scanning Systems: A Technology Survey* for further reference.

PART 5. BRIEFING AND DISPLAY

INTRODUCTION

Command center operators and decision makers require diverse kinds of information in order to carry out their responsibilities. To be useful, this information must be displayed in an appropriate form and in a timely manner. While various communications and information processing elements serve the needs of the analysts and action officers who collect and interpret data, the briefing is the most common and efficient vehicle for communication of information to a decision maker. The components and procedures that contribute to the assembly, control, and presentation of a briefing constitute the briefing and display subsystem, as defined in the command center system architecture.

Scope of the Briefing and Display Subsystem in Concept

Because BDS components format and present information that is obtained and developed within the communications and information processing subsystems, there is necessarily some overlap between the three subsystems. For example, IPS computers provide the ability to create briefings, as does the multimedia briefing workstation within the BDS, and video teleconferencing requires the coordination of both video communications and display capabilities. For the purposes of developing a conceptual model of the subsystem, however, some functional boundaries have been drawn.

Those aspects of briefing preparation that are similar to the steps involved in preparing a report, memo, or other paper-based information product are considered part of the IPS; these functions include generating or obtaining information, formatting it in text or graphic form, planning the order of its presentation, and generating hard copies. In contrast, those aspects of preparing an information product that apply only to a briefing are considered part of the BDS. Functions such as incorporating sound or video in a briefing, presenting a briefing, and enabling real-time annotation of text and images are exclusively part of the BDS. This conceptual division of functions reflects the equipment and applications that will be used: while an action officer could create simple briefing pages on a basic IPS workstation using a graphics or word-processing program and print the pages as view-graph transparencies on a laser printer, the action officer (or, more likely, a trained BDS staff member) will use BDS components such as a frame-grabber, videotape recorder, display controller, and multimedia workstation to coordinate and present a more sophisticated product.

Planning

When developing a command center BDS configuration, planners must recognize a number of factors influencing the three functional areas of acquisition, manipulation, and display. They must anticipate how the information flow within the command center will affect — and be affected by — the prospective BDS elements. Major questions to be asked when developing BDS requirements include:

- What types of information sources need to be supported? Sources could include videotape recorders, video disks, and broadcast video; hard copy, such as paper documents, photos, or maps; 35 mm slides or view-graphs; and video, text, and graphic databases.
- How compatible are the different types of data? Access to sources and integration must both be considered.
- What kinds of manipulation may be needed? The capability for adding and editing text and images is essential in the command center environment, as is the ability to overlay icons and notes on images, potentially in real time. The ability for a technician or the briefer to control the presentation of a briefing electronically may be considered a "must-have" due to the flexibility and security benefits it offers. Additionally, some organizations may have a need for animation, 3-D rendering and modeling, or video effects such as special transitions between briefing materials.

- How will the display system be defined? Integration of video and computer graphic output may be required. Planners must also consider display screen size, as determined by the number and distribution of people intended to observe presentations.
- What are the user requirements? Ease of learning, as well as ease of use, is important. Prerequisite skills for involved personnel and the number of staff available will influence how complex or simple a system should be.
- What quality of graphic output is necessary to achieve the briefer's goals in communicating information? Display quality is a result of image brightness and contrast, resolution factors, and color capability.
- How quickly must the briefing be prepared? Does everything have to be available in real time?
- What are the long- and short-term information storage needs?

The answers to these questions will vary according to command center applications. A carefully constructed statement of requirements will assist in identifying system capabilities that satisfy the command center requirements without overkill.

BDS Capability Areas

In order for these functions to be supported adequately, technical arrangements involving a number of different disciplines must be in place. The briefing and display subsystem portion of the command center system architecture defines six areas of briefing and display capability: external audio/video/data interfaces, multimedia briefing workstation, switching and distribution, audio/video inputs and outputs, displays, and control.

Standards

Current and emerging standards have been identified for several briefing and display capabilities. Because the technologies within the BDS are extremely diverse – spanning a range from keyboards to various types of projection systems – applicable standards are discussed in the sections covering each capability.

EXTERNAL AUDIO/VIDEO/DATA INTERFACES

External inputs to a briefing can include broadcast video, teleconferencing feeds, data from the information processing workstations, and maps maintained or generated on electronic mapping applications.

Information from IPS Workstations

One of the major decisions involved in preparing graphics with information from external sources is the question of where the actual data manipulation should be performed. If done on a shared basis over a local area network, a workstation can obtain data from the main database and manipulate it locally using dedicated hardware and software, only occasionally going back to the mainframe for support in heavy computations.

Video Teleconferencing/Video Acquisition

These areas are addressed under Video Teleconferencing in Part 3, Communications.

MULTIMEDIA BRIEFING WORKSTATION

Introduction to Multimedia

The melding of audio, video, and text under computer control has emerged as a potential means to convey information far more effectively and efficiently than ever before. The development of multimedia-based information systems has been touted as one major direction that the computer industry is developing. In relation to briefing and display technology, the idea of a multisensory approach to communicate information will greatly impact the quality and speed with which a command accumulates, manipulates, displays, and manages various forms of information. Multimedia computing applied to briefing

and display duties holds great potential as a tool to streamline access to large amounts of pertinent information. In order to understand multimedia's potential for briefing and display applications, a basic definition – or two – is needed.

The term "multimedia" conjures up different meanings to different people. Multimedia has been loosely targeted by groups in the computing, television and entertainment, consumer electronics, telecommunications, education, and even the publishing industries. Each industry has its own unique multimedia requirements and because multimedia is still in its infancy, there is a lack of standards defining a multimedia system platform or solution. In general terms, however, multimedia is defined as the integration of several inputs of different types, including text, graphics, audio, animation, and video, into a single computer document. To qualify as "true" multimedia, a document must incorporate at least two media in addition to text. The source media in one document may involve several different technologies, standards, and software applications. A multimedia document is by definition interactive: the audience can activate the different elements at will, or dictate the order in which elements are presented. The computer system serves as the "managing supervisor" of the peripheral hardware where the source media information is kept. Software acts as the "media director," allowing the user to view, create, edit, manipulate, and display the various media. This is illustrated in Figure 5-1.

The State of the Art

Although "multimedia" in its different forms is supported by various products developed by the different groups noted above, the "multimedia briefing workstation" for command centers exists only in concept. The command center target architecture describes an integrated, NDI computer-plus-peripherals suite running software that will be capable of performing the full range of planned multimedia functions. At present, command center users can implement a subset of full multimedia capabilities. Multimedia applications such as Macromind Director can be run on existing computer equipment, and video input and output devices can be linked to the system. This type of implementation enables the user to combine graphics, text, digitized photos, sound, and animation, and to create a presentation that responds to the audience by providing preprogrammed supplementary information or by presenting questions and checking answers. Multimedia technology is claiming a growing role in education, and its current capabilities make it suitable for producing training materials for the command center. Creation of a sophisticated multimedia file and coordination of the various elements is time-consuming and computer-memory-intensive, however. Given that the goal of automating briefings is to simplify and speed production so that information reaches the decision-maker in a timely fashion, "true" multimedia is not yet an off-the-shelf tool suited to command center users.

Given the state of affairs just described, it is necessary to adopt a working definition of the term multimedia. True multimedia can be compared to the target command center architecture: its future is visible but not yet reachable. The working definition of multimedia corresponds to the current command center architecture: until the target is achievable, upgrade efforts will focus on a less-capable interim version of the technology that can be enhanced as technology advances. For this purpose, multimedia can be considered to be the integration of fewer media – for example, text and still video, or computer-generated graphics and audio. The requirement for multimedia documents to be interactive is set aside for this working definition; the lesser capability that takes its place is the ability to deliver a briefing from the workstation or other automated system.

Near-Term Developments

Quicktime

Developments on the horizon may accelerate the thrust of multimedia technology and allow users to employ multimedia in any software application. Apple's Quicktime, scheduled for initial release in early 1992, is an extension to Macintosh operating system software that will allow users to add video, animation, and sound to virtually any document, including some in non-Macintosh environments. Command center personnel could continue to use their preferred word-processing, database, or briefing preparation software and incorporate still or moving images and sound in them, rather than coordinating numerous inputs in a "media director" application. The initial release of this product will almost certainly be inadequate for practical use, but it may, if successful, determine the course of future developments.

Visual Processing Workstations

Multimedia technology may also build upon currently available high-end "visual processing" workstations for briefing preparation. Visual processing, based on Reduced Instruction Set Computing (RISC) technology, gives the user an ability to visualize and interact with graphic work, providing an efficient way to present complex information. RISC technology makes available the large amounts of processing power required to work with graphical

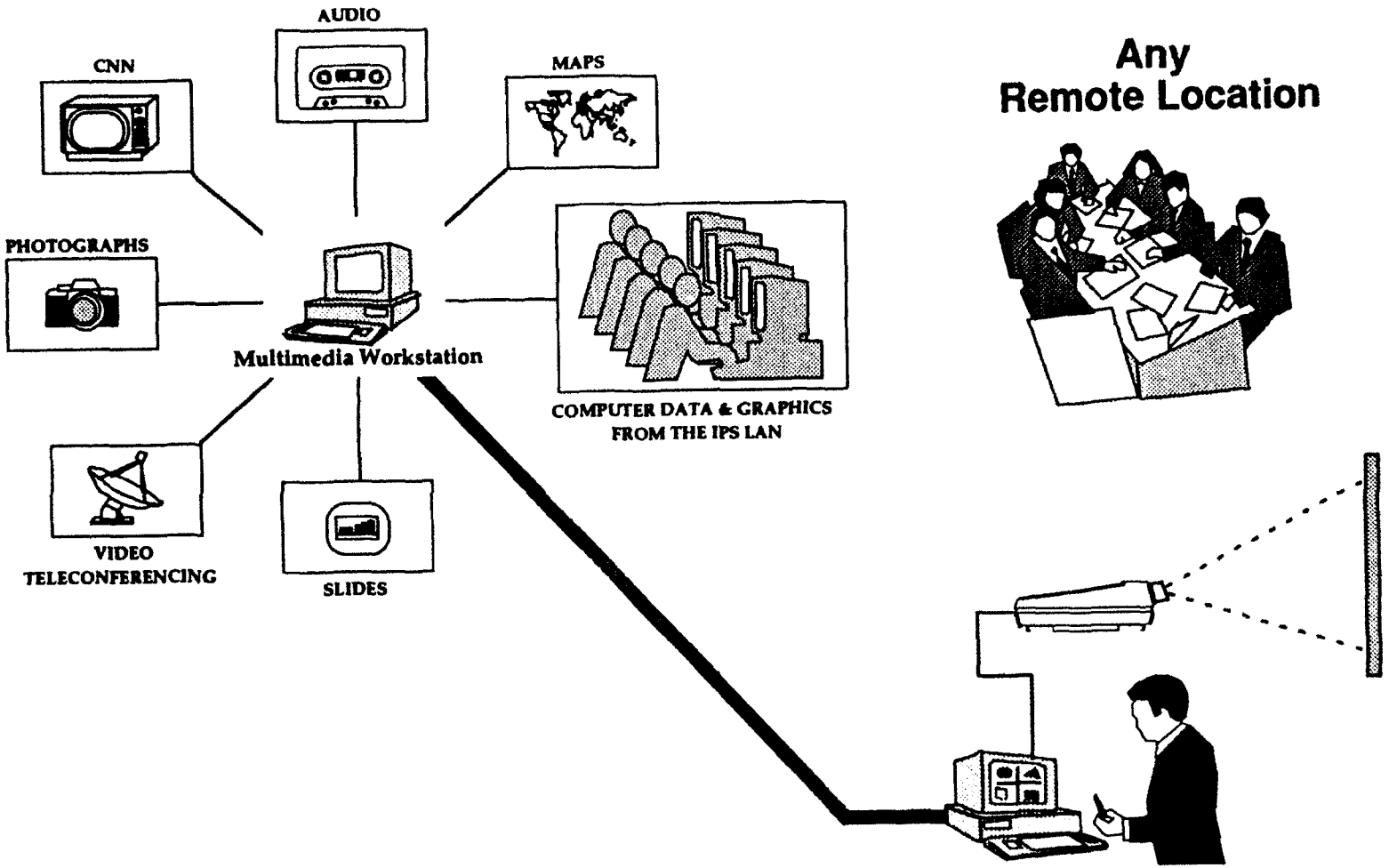


Figure 5-1. Multimedia Briefing Workstation

information. A key processing specification known as MIPS (execution of millions of instructions per second) determines raw computer processing speed with which graphics can be created and edited. The greater the MIPS specification, the faster graphical data can be rendered, edited, and redrawn.

With visual processing workstations, photo-realistic imagery can be created and placed into a briefing with other pictures and/or textual data. The concept of layering multiple graphical images is known as compositing. These graphics workstations, initially limited to engineers, designers, and scientists, are now comparable in price and availability to high-end PCs. Networking capability standards such as TCP/IP, X-windows, Ethernet and FDDI are supported by some manufacturers. Workstation products from companies such as Silicon Graphics, Sun, and Hewlett-Packard, and software packages from companies such as Wavefront Technologies and Alias Research are current players furthering the developments in visual processing technology.

As the visual processing field develops, analog video-based information will be easily incorporated into briefing and display systems. For example, capturing tactical information "live from the field" to be played back for analysis and discussion during a crisis situation will be facilitated.

Dealing With Multimedia Now

Command center users have the opportunity to come to terms with multimedia technology in its infancy. Incremental improvements, as identified in the near-term command center architecture, will ease the transition to new technology and minimize investment in dead-end solutions. For example, electronically integrating just text and computer-generated graphics in briefing preparation or electronic publishing applications is a step toward multimedia, and one that provides a significant increase in efficiency in its own right. Additionally, users can begin to compile libraries or databases of video and graphics. The command center community's involvement and interest in multimedia may also prompt the development of products to reflect their particular needs.

The following paragraphs describe a workstation configuration that can support current and emerging multimedia applications. Much of the detailed information is based on systems that support computer- and video-based graphics production. Because graphics will be a major component of multimedia documents, and because graphics production is in itself one of the most demanding aspects of the command center BDS environment, a computer system that is designed to optimally support computer- and video-based graphics production is most likely to satisfy multimedia requirements as they develop.

Standards

Currently, there are no established standards governing multimedia. The absence of standards, coupled with the wide range of user-specific applications, has led to the formation of a trade association addressing multimedia-related issues known as the Interactive Multimedia Association (IMA). The IMA represents over 170 major companies involved in interactive video and multimedia technologies and has become the singular think tank supporting the standardization of multimedia technologies. The IMA Compatibility Project is currently addressing multimedia compatibilty issues.

In the area of still-image compression, JPEG (Joint Picture Expert Group) data reduction schemes have emerged with support from many vendors targeting the multimedia marketplace. Development to standardize data reduction schemes for motion image applications is focusing on MPEG (Motion Picture Experts Group) compression techniques.

MIL-STD-1379D and MIL-STD-1322.20 indirectly relate to multimedia requirements for military training programs and may provide leads toward additional standards.

Multimedia Workstation Components

Multimedia workstation components include the host computer, acquisition devices, manipulation devices, storage devices, and hardcopy devices.

Host Computer

The personal computer has emerged as the platform for the development of multimedia-based information systems. The majority of system peripheral hardware equipment and software development supports computer systems built by Apple, IBM, Commodore, and Sun. These manufacturers are the predominant players in multimedia-based computing supported by third-party vendors, and currently do not conform to any universal standard that would promote interoperability.

The Microsoft Corporation has made recommendations for baseline multimedia creation and delivery systems for the DOS-based environment, as shown in Figure 5-2. Neither Apple nor Commodore have specified minimum platform configuration requirements for multimedia applications; however, the Apple Macintosh II family (including the Mac IIx, IIci, and IIfx machines) and the Commodore computer family (including the Amiga 2000, 2500, and 3000 computers) currently support advanced graphics uses and are used to host what multimedia products presently exist. Apple and Commodore have not, however, recommended specific add-on devices or software products as absolute minimum requirements to develop a fully functional multimedia workstation. These products, (CD-ROM drives, laserdisk recorders/players, video frame grabbers, etc.) are application-specific and should be tailored to a command center's unique briefing and display needs.

Base Delivery System

- 10MHz + 80286 or 80386
- 2 Mb of RAM
- Standard/enhanced VGA graphics
- 30 Mb hard disk
- CD-ROM drive
- Windows multimedia environment

Base Creation System

- 80386
- 4Mb of RAM
- 8-bit (256 color) VGA card
- 3.5" 1.44Mb floppy and 80Mb+ hard disk
- CD-ROM drive with controller card

Figure 5-2. Microsoft's Recommended Configuration for multimedia PCs

Speed and Processing Power

Processing speed for a host computer is a key factor when personnel are creating, editing, or displaying computer graphic data. The principal command center requirement appears to be the rapid development and display of single-frame graphics. Speed therefore refers to the time required for a graphic system to develop and display a single frame image. During such development, there is a repeated need to manipulate the partially completed graphic by adding details, editing, and so forth. Each of these activities requires the graphic to be completely redrawn by the computer. For example, after working on a small portion of the graphic, the operator zooms out to a full view. To obtain this view, the entire image must be redrawn on the screen. Each of these operations takes time, and it is computing processing power that determines how much time will be involved. The term clock speed, one element that determines computer processing performance, refers to the pace at which operations proceed within a computer's internal circuitry. Faster clock speeds are always desirable when developing a briefing system, because they translate into noticeable speed gains in tasks such as redrawing graphics. PCs incorporating the Intel 80486 microprocessor (IBM and clones) operate at speeds that range from 16 to 50 Mhz. The general rule of thumb "faster clock speeds yield faster performance" is helpful to remember when purchasing a host system for multimedia applications, although it is not the sole guarantee of good performance.

Enhancements in processing graphical images can also be made using math co-processor chips and graphic accelerator boards. These add-on products reduce the "number crunching" demands made on a host computer's central processing unit (CPU). With the advent of RISC-based technology, 3-D rendering and modeling has become less taxing on a computer's CPU. Therefore, the requirement to develop graphics without continually waiting a long time for the computer to repeatedly redraw the image is very important.

Computer-Based Acquisition Devices

Acquisition devices for computer-based graphics systems include keyboards and related devices, optical scanners, and frame grabbers.

The ergonomics and form factors of keyboards have been evolving for years. Key "feel," positioning, dedicated functions, and "soft" (user-definable) keys have all improved markedly. However, keyboard layouts are still not standardized. If an operator becomes used to a particular set and layout, he or she may lose efficiency and make more errors when transferring to a different keyboard.

Other input devices include the mouse, joystick, and digitizing tablet. The most popular device in this category is the mouse. These devices are relatively inexpensive, but they do not allow precise pointing control. A digitizer tablet is considered the best pointing device. It senses location of an electronic puck

on its surface with great precision. The puck usually has crosshairs and a magnifying lens for precise pointing (e.g., at map outlines).

Information can also be entered into a computer system by means of an optical scanner. An increasing number of optical scanning products offer the ability to bring hardcopy images, text, and maps into a computer environment for further manipulation, storage, and display. (Scanners are discussed in Part 4, Information Processing, under the heading "Office Automation," and selected scanner product evaluations are included in the IPS "yellow pages.")

- Frame grabbers. Digital storage of single frames of video is required for later image manipulation, so graphics systems must be able to capture and digitize a single analog video image. Most graphics systems can digitize a video image in one frame (or one field), and are thus useful for extracting moving images from videotape.

Manipulation Applications and Devices

In a command center briefing situation, the visual information to be presented is usually configured as a series of briefing frames conveying text, maps, charts, and pictures. For some applications, motion video may also be used. Manipulation involves the composition, editing, annotating, and combining of these forms of information to create the desired visual image. The equipment selected to perform these tasks forms the core of a multimedia briefing system. The principal multimedia manipulation device is the workstation itself. Most command center computer graphic applications are found in workstations that are typically mini- and PC-based. With the increased presence of units such as IBM's PS2/80, PC486s, and those from Apple's Macintosh family, the price/performance ratios associated with these and other workstations have improved greatly. Standalone PC units are proliferating because they can be customized for graphics relatively inexpensively through the use of plug-in boards and software. Manipulation devices can include annotation systems and digital video effects units.

Annotation Devices/Applications

Character generating devices are one way to annotate briefing slides. Once performed by a separate piece of hardware, character generation is now being introduced as plug-in boards and software combinations for graphic overlay created with a PC. The legibility of text when presented in a computer video format depends to a great extent on the size and shape (font) of the letters, their color and that of the background, plus how well they are reproduced. The falling price of memory has made character generation applications less expensive. Manufacturers of products of this type are incorporating additional features, such as retouching and digital effects, with their board-level products.

Other types of annotation applications serve the purpose of enhancing captured images and creating new slides. Using an input device, generally a stylus and digitizing pad, an operator can encircle portions of a briefing slide to focus attention on a particular area of an image or underline important narrative. The technique is similar in function to tools announcers use when analyzing playback during sporting events; a commercial product called the Telestrator is an example. The available features generally support all functions available to an artist with brushes, paint, and paper.

Digital Video Effects Units

The function of a digital video effects (DVE) unit is to produce effects such as re-sizing a video image, inverting, rotating, and performing image "fly-off" or other slide transition effects. This manipulation can be done on individual video frames, as single-frame graphics, or on full-motion video at 30 frames per second. The more expensive systems will support additional effects and allow video transition effects to be stored on floppy disks.

Storage Devices

Images can be stored for the long term both as data files and as raster video. New advances in the material composition of laserdisks for image archiving will soon yield storage shelf life expectancies approaching 100 years. For a command center, the storage types discussed below should be considered. It should be noted that these output storage devices also become input acquisition devices when called upon to replay data. Traditional stand-alone slide store (still store) devices are being replaced with frame-grabber-to-local-PC mass storage configurations. Their accessibility and compatibility must be taken into account when defining video graphic systems.

Floppy Disks

The use of this form of storage is very limited because of disk capacity. To put the storage problem in perspective, the active picture information produced in one digitized NTSC composite video frame (excluding horizontal sync and vertical blanking) is approximately 1 megabyte. The storage capacity of a typical high-density floppy disk is about 1.44 megabytes. This means that

a single NTSC composite video frame in digitized form requires almost the entire storage capacity, or more, of a floppy disk. "Inter-frame" compression techniques, similar to those developed for video teleconferencing codec products, can compress a video frame into approximately 12 kilobytes, although some degradation of the reconstructed image may be noted. An offshoot of floppy disk technology allows 50 fields (25 frames) of analog component video to be recorded on a 2-inch magnetic disk using products such as Sony's Pro Mavica still frame recorder. There are currently several add-on boards employing JPEG compression algorithms capable of compressing digitized video images at ratios up to 100:1.

Hard Disk Packs and Slide Stores

Generally utilizing Winchester Disk technology, the storage capacity of these systems is very large. To utilize disk space efficiently, various techniques for data compression or reduction are applied. These differ depending on the format and content of the data being generated. Efficient packing of image data files leads to two major improvements. One is the ability to store many more images onto disk, and the second is a significant increase in file transmission speed between computers.

Vendors such as Harris, Quantel, Leitch, and Abekas provide hard disk units that store video frames digitally. This allows both manipulation and archiving with fast access to frames and no image degradation. Usually, only single still frames are stored. The number is limited by the capacity of the disk storage medium. Some units now allow up to 100 seconds (3,000 frames at 30 frames per second) of real-time motion storage. Most slide stores allow access to the disk from multiple locations so that 2 or 3 briefers can simultaneously be working on briefing frames without mutual interference. The briefing frames can be called up for simultaneous display in different locations, if necessary.

Hard disk video "library" systems are also available. They provide storage plus other functions, including multiple outputs, manipulation capabilities, multiple user inputs and outputs, etc. Removable disk cartridges such as the Bernoulli disk cartridge permit classified video and computer-generated images to be removed and placed into secure storage.

Optical Disks

Read-only and recordable optical disks are currently available for command center applications. They can store computer data, text, digital audio, and digitized video. The data is stored on an optical disk in either analog or digital form. The optical laser videodisk, such as those used in training programs, uses the analog approach; the compact disk-read-only memory (CD-ROM) data store uses digital techniques. The major difference between the two technologies with respect to graphics is that the CD-ROM can currently transfer data only at a rate equivalent to a few video pictures per second (NTSC video requires 30 frames per second) and thus without special compression techniques cannot provide full motion video. The 12-inch laserdisk has the ability to store over 54,000 frames of video or 30 minutes of motion video on a single platter. Until recently both technical approaches used disks pressed from a master disk to replicate material. This process was expensive and time-consuming. Changes to the database required remastering, and the only programs and data being stored were those with commercial value. The advent of DRAW (direct read after write), WORM (write once, read many), and Erasable Magneto Optical (MOE) capabilities now means that fast, locally writable storage is available. Thus, large amounts of locally customized data (force compositions, etc.) will now be recordable and accessible at a command center.

Hardcopy Devices

Hardcopy devices are discussed in Part 4, Information Processing, under the heading of briefing preparation.

Issues Relating to Multimedia Workstations

Solutions based on computer and video technologies will not resolve all problems; there are a number of issues to be sensitive to when "systemizing" the emerging desktop videographic technologies. They include:

- Compatibility with existing and future technologies
- Modularity of components
- User-friendliness
- Maintenance.

In relation to compatibility, videographic devices, including stand-alone equipment and software, will become more of a detriment than asset if they are:

- Not supportive of an open architecture or open-ended in design

- Proprietary in function (not flexible enough to perform many tasks)
- Proprietary in specification (with hardware and software not adhering to industry standard techniques such as the emerging image compression algorithms, JPEG and MPEG)

Modular videographic system components should be transparent to the end-user and require minimal physical reconfiguration. They should be easily repaired through hardware and/or software module replacement. They should also include the capability to be updated easily through hardware or software upgrades.

The end-users of videographic products should be permitted to develop as creative types as opposed to exclusively technical equipment specialists. The following considerations apply to the development of in-house videographic experts:

- Managers must realize that not all components are user-friendly and will require training
- Managers should allow and encourage users to develop skills through manufacturer-sponsored training courses
- Users should maintain relationships with equipment manufacturers, suppliers and integrators, and communicate criticisms and praises to them, because they may incorporate such feedback into their products and services.
- The staff should promote a creative, non-sterile environment for briefing creation. Users can create more powerful presentations with videographic tools, but should avoid being showy or glitzy.

Maintenance issues are important when selecting videographic products. Excessive downtime cannot be tolerated, especially during a crisis situation. Equipment users and managers should maintain:

- Full awareness of equipment warranty information
- An appreciation of the value of following routine scheduled maintenance
- Spares for hardware modules such as power supplies or plug-in boards
- Backups for software-based systems (image database libraries, redundant textual overlay data, etc.)
- The flexibility to take advantage of upgrades (especially software) if cost-effective and enhanced system performance can be predetermined
- Awareness of consumables required for daily and extended operation.

Future Multimedia Technology

Over time, the classic static image and character-generated text-based graphics systems will give way to the multimedia briefing workstation techniques discussed previously. The continued merging of computers and video will evolve into exclusive computer-based system dominance, offering increased flexibility over its video-based counterpart. There will come a point in the future when analog video-based graphics components will become obsolete. The standalone character generator, used for textual overlay onto a video image, will reside on a silicon chip inside a multimedia briefing workstation. An all-encompassing digital video post-production station will provide the graphic artist/computer videographer with tools to acquire, manipulate, output, and store motion and still video imagery, sound, and computer graphic data.

Offline still-video and even motion image databases will become an asset as digital video technology begins to permeate the video industry. For this capability, however, end users will initially pay a premium. Manufacturers will need to recoup costs spent on research and development, as the field of digital video is in very early stages of development. The advent of graphical databases will give briefing personnel flexibility to create briefing slides using a library of stored images to communicate information. A graphic artist will have still and animated graphic sequences accessible via a computer connected to mass storage systems such as CD-ROMs. The approach to slide creation will be similar in function to the use of a clip art library by electronic-publishing personnel supplementing written documents with illustrations. The computer will continue to handle the traditional duties of a character generator, overlaying alphanumeric characters to further enhance visual information during briefings. These and other future trends will be based more on computer-oriented applications with less dependence on stand-alone, single purpose, analog video devices.

The price/performance ratio in video graphics is improving simultaneously with a decrease in the cost of computer memory and increase in processing power. With more cross-feed of knowledge between the two disciplines and the coming availability of new storage and retrieval tech-

niques, a briefer will have access to some very sophisticated graphic generation tools. The field of desktop video is beginning to take form as manufacturers develop and integrate products that are marrying video production with stand-alone computing platforms.

Computer-Based Systems

Projected developments will affect:

- Workstations. Workstations will grow as the focal point for the user in a graphics environment. Where the early products were essentially computers with graphics added as an afterthought, the later generations such as products available from Silicon Graphics, Sun, and Hewlett-Packard have developed to the point where high-speed operation is now available on 32-bit RISC CPU products selling in the $10-30,000 range. Products that originally started in the home and business environment, such as Apple Macintosh and Commodore Amiga, are also finding a place in the command center graphics environment.
- Microcomputers. The PC is becoming more powerful. Products like the Commodore Amiga use separate display processors and offer relatively high-resolution graphics at prices in the $1,000 - $3000 range. It is now possible to buy graphic boards that are so fast that the limiting factor on full utilization is the internal bus structure of the host personal computer. The popularity of desktop computer graphics is growing, featuring color graphics, animation, and video handling capabilities. The use of add-on hardware in personal computer platforms is creating a new field known as desktop video. One such product, the Video Toaster from NewTek, is a multi-functional expansion board for the Amiga personal computer that provides the capabilities of a video post-production facility on a desktop. Multimedia software developments are offering briefing preparation personnel very powerful tools from which to choose.
- Resolution. It is possible to obtain display resolutions of up to 1,280 x 1,024 pixels with plug-in graphics boards. Designers have been pursuing better resolution with existing RAM and specialized hardware that offers faster line and screen fill speeds. Their goal is to achieve easier and more efficient graphics creation and manipulation by eliminating long processing delays.
- Image capture. Image capture systems will represent a major advance over manually directed graphic digitizers. They use high-resolution cameras to convert any two-dimensional drawing or three-dimensional object into computer graphic data.
- Memory. The drop in prices has brought about some reduction in the cost of memory-intensive products. This will be reflected in graphics system designs by encouraging faster, less costly systems, which will approach the capabilities of high-end video-oriented products available today.
- High resolution with "downward compatibility." High resolution systems that can be viewed on a standard 525-line monitor will become available. Systems based on 1050 scan lines (exactly double the NTSC standard) are particularly amenable to this.
- Standards. Standards committees are close to agreement on methods of handling and formats for both analog and digital video. This means that manipulating video will become easier as manufacturers introduce or modify existing products to the standard. It also means the video world will become more adept at handling digitized video, which will generate a move to more "computer-like" techniques of transmission, storage, error correction, etc.
- Local area networks. With the increased ability to handle digitized video, LANs will become more popular in the video area, driven at first by the need to interconnect the new digital videotape recorders with digital storage and manipulation devices. As digital video becomes more available, the pressure to merge video databases with computer databases will increase even more. The problems of standards and interconnect protocols, however, will require the further development of specialized hardware and software.

SWITCHING AND DISTRIBUTION

NOTE: Switching systems are discussed more fully in the next section, under the heading Switching Systems for Routing and Distribution. Refer to Part 3, Communications, for a discussion of video communications processing.

Standards and Guidelines

In the current BDS architecture, the capability for distribution control will be supported by a Serial Data Standard, such as EIA RS-232-D. In the target

architecture, control may be by LAN. EIA RS-232-D will become a LAN standard. The distribution bandwidth capability will be supported by a 70-100 MHz standard and the capability for distribution methods will be supported principally by analog, electronic, and component video switch standards in the current architecture. In the target architecture, the bandwidth is expected to increase to 100-150 MHz, with fiber-optic switches or LAN devices replacing analog, electronic, and component video switches.

AUDIO/VIDEO INPUTS AND OUTPUTS

Audio/Video Acquisition Technology

Acquisition devices provide the input data for briefing creation systems. The information presented below briefly reviews acquisition devices for audio, video and computer-based systems.

Audio-Based Technologies

The use of audio in briefings has had little exposure to date; however, practical applications for it do exist. Recording a briefing "live" for subsequent playback requires acquiring the audio narration portion that may accompany a visual presentation. As another example, someone briefing a large audience may require sound reinforcement to overcome inaudibility. In addition, pre-recorded messages (storable within a multimedia workstation) can be linked or "cued" to briefing slides, adding impact to convey information more effectively.

Basic elements for providing an audio capability to support briefing presentations include:

- Microphones
- Sound reinforcement equipment
- Audio recording/playback devices

Microphones

Microphones come in a variety of designs for a variety of applications. As a basic definition, a microphone is a transducer which converts acoustical energy into electrical energy. Microphones will interface with either recording devices or amplifier/speaker combinations. Distinguishing characteristics of microphones include their construction type and their directional pick up pattern (also called polar pattern). Selection criteria should focus on these two areas.

Microphones function using different techniques to convert sound into a varying electrical signal. Those most applicable to a command center include dynamic, condenser, and boundary microphones.

Dynamic microphones - are constructed as a wirewound coil suspended in a magnetic field attached to a moveable non-magnetic diaphragm. As sound pressure level (SPL) changes occur at the microphone element, the coil and diaphragm assembly move in accordance with these changes. A varying output voltage is produced from the vibrations caused by the sound entering the microphone element. Dynamic microphones are low impedance microphones that provide good to excellent frequency response and are fairly rugged and inexpensive.

Condenser microphones - use a slightly different approach to converting sound into electrical signals. The capsule of a condenser microphone consists of two thin plates; a movable insulating diaphragm and a fixed conductive plate. Changes in SPL cause the capacitance of the microphone assembly to change, which results in a output voltage change. Because this varying output voltage signal is small in magnitude, a condenser microphone will have amplifier circuitry built into the physical microphone housing. This in turn requires the use of a power source for the microphone to properly function. Power can be provided from a small battery or dedicated power source, often referred to as phantom power. Condenser microphones are high impedance microphones and are very accurate in capturing and converting audio signal information such as voice and music. These high quality microphones are used in a variety of sound recording and reinforcement applications where faithful accuracy is paramount. Pricing is generally higher for condenser microphones than for dynamic microphones as their design is more robust.

Boundary microphones - are also known by the trade name Pressure Zone Microphone (PZM). The principle of operation is based upon the behavior sounds exhibit when they approach a boundary such as a wall, table, podium or floor. A thin acoustic zone is created in which reflected and direct

signal paths reinforce each other as opposed to cancelling each other. If a transducer (microphone) is positioned within this area, a high quality audio signal with flat frequency response can be captured. PZM microphones are highly sensitive and exhibit a wide pick up pattern. The PZM is ideal for recording conference room and round table discussions and can also alleviate the need for multiple microphones to be placed on a podium.

Additional Microphone Considerations

Directivity and sensitivity are additional specifications that are important to understand when selecting the proper microphone for a particular application. A graphic specification provided by manufacturers to illustrate the relative output and directivity of their microphone products is known as the polar pattern response or polar pattern. Polar patterns provide a pictorial representation of microphone sensitivity at varying angles in a 360-degree circle.

Microphones are available as either hand-held, lavalier, or wireless units. The lavalier is typically a condenser microphone that is small enough to be clipped to a collar or lapel. The lavalier provides a speaker or briefer with hands-free operation to present information, pass out literature, etc.

Although wireless microphone systems do not represent any advance in generic microphone technology, they do provide improvement in terms of convenience. When complete, unrestricted mobility is required for the briefing presenter, a wireless microphone system best performs this duty. Wireless microphone systems generally consist of transmitter and receiver units, antennas, and the microphones themselves (lavalier and/or hand-held). Radio frequencies are assigned to a complete system, and the microphone basically broadcasts from the transmitting to the receiving unit. It is important to note that a separate transceiver and microphone operating at a specific frequency will be required if more than one microphone is to be used at a time. Security issues must be considered, as audio from a wireless microphone system, much like a cordless telephone, can be easily intercepted using basic communications equipment. Frequency allocation must be also known in advance to avoid interference with other radio communications equipment within the command center.

Sound Reinforcement

Audio reinforcement or public address systems are not widely employed within a command center. They can be used, however, in an auditorium setting when guest lecturers or visiting briefers conduct meetings or briefings for a large audience. Sound reinforcement systems include audio amplifiers, audio processing equipment such as audio equalizers, microphones, and speakers, and the necessary cabling to interface these elements together. The actual physical layout for an auditorium or other conference room greatly influences acoustic quality and will determine if sound reinforcement is required. Each acoustic space is unique and no two auditoriums are alike. Therefore, a basic room analysis might include:

- Conducting subjective speech intelligibility tests to determine how well a lecturer can be understood from different locations within a room.
- Determining whether the room is more reverberant or anechoic in nature
- Providing the proper acoustic treatment as needed for better sound control, including installing or removing sound absorbing materials such as carpeting
- Considering sound reinforcement to overcome acoustical barriers within the room.

Sound reinforcement does not have to involve the massive amounts of equipment typically found in a concert hall. A sound system design should be subtle, unobtrusive, and complementary. A sound system design must not overpower the audience. Facilities personnel may provide valuable insight on better ways to overcome acoustical deficiencies inherent in a large briefing room or auditorium.

Audio Recording/Playback Devices

Audio recording and playback devices include analog cassette recorders, digital audio tape recorders (DAT), open reel recorders, compact disc players, and audio digitizing plug-in boards for computers. Audio recording devices can be used to "capture the moment" during briefings and other lectures. Audio playback devices can be used to supplement briefing presentations by adding impact to visual information.

The professional audio community continues to shift towards digital-based audio systems as a more efficient means for recording, archiving and playing back audio information. The incorporation of audio in the PC has created the "tapeless studio" in which audio can be recorded, edited, and stored, all within the digital domain. The advent of a digital audio workstation offers unsurpassed sound quality, random access, and sound degradation immunity. The command center can benefit from these developments, because COTS digital audio capture/playback boards and associated software are available to be incorporated into a multimedia workstation. Now a briefer

can supplement a presentation with audio snippets, such as a portion of a pre-recorded speech that may be relevant to a briefing slide. The technology provides the potential for automating a briefing through the use of "canned audiovisual briefing slides." A multimedia workstation can orchestrate and run a computer graphic slideshow, playing back accompanying audio that has been digitized.

Video-Based Acquisition Devices

Video input/output devices include video cameras, videotape recorders, laserdisk player/recorders, the multimedia workstation, and display devices. (Display devices are discussed later in Part 5.)

Video Cameras

The range of available video cameras is large. Selection factors include:

- Resolution. The camera should have adequate bandwidth so as to be transparent to the rest of the system.
- Sensitivity. Depending upon the operating conditions (e.g., well-lighted copy stand, low-lighted conference room), a camera that will give full video levels under all operating conditions should be selected.
- Signal-to-noise ratio (SNR). 50 dB or more is recommended.
- Features and functions. Depending on local system needs, these requirements may include remote lens control; component (RGB), composite video (NTSC), and S-VHS outputs; and automatic set-up and diagnostics.
- Choice of optical device. For command centers, where reliability and minimal down-time are very important, the use of solid-state charge-coupled device (CCD) cameras is desirable. CCDs replace vidicon tubes as image sensors. They are lighter, more rugged, and consume less power than tubed cameras. Also, they are less susceptible to strong magnetic or electric fields. CCDs turn on instantly, provide perfect picture geometry, and never display registration or shading drift, "blooming," or "comet tails," as do tube cameras. CCDs do, however, exhibit some deficiencies when compared with tubed cameras: lower picture quality, "aliasing" (image flashing), "fixed pattern noise" (tubed camera noise is random), and greater RF interference susceptibility.

Videotape Recorders

In many situations, motion pictures must be recorded for later editing and analysis. The quality of the videotape recorder (VTR) is critical to the quality of the final video images. Tape size, recording format, and maintenance state all contribute to the end result. The principal VTR formats are:

- 1/2" tape, VHS , Super VHS (S-VHS) or Beta. Typically, these are consumer units used in low-end industrial and home applications, with low resolution and marginal color performance. S-VHS is an improvement in picture quality over standard VHS. S-VHS tapes can only be recorded or played on S-VHS VTRs and use a specially formulated videotape medium. S-VHS compatibility issues should be recognized, especially if tape interchange will take place among groups both within and outside the command center community. In addition, S-VHS to RGB format translation is required for distribution switchers.
- 8mm and Hi-Band 8mm (Hi8). Its small size and superior picture quality have made this format increasingly popular. Tactically, 8mm. video technology was used to a great extent during Operation Desert Storm.
- 3/4" U-Matic. This format is capable of reasonably good pictures but horizontal resolution is limited to about 2/3 of NTSC's ultimate capabilities.
- 1/2" Betacam, 1/2" M and 1/2" MII. New formats from Sony and Panasonic that utilize a direct component recording technique (separation of red, green, and blue color information) delivering a very clean picture image.
- 1" C. This top-end broadcast standard produced by Ampex and Sony provides a wide range of capabilities from highly flexible edit functions, digital audio, and "slow motion" effects to still frame recording capabilities for animation and archival storage.
- D-1. Using a 19mm (nearly 3/4") cassette these units record in a digital format. Although extremely expensive today, they will be widely utilized for the storage and manipulation of video images within a few years.

Other video recording formats are developing. Still video systems that are truly digital have yet to be marketed and their future is presently unknown. There is also a new 1/2" composite digital video format that is currently being introduced by Panasonic. Selection of the correct format for a command center application requires consideration not only of local requirements, but also of

whether interchange of tapes will be required with outside organizations. Planned future growth must also be taken into account.

DISPLAYS

Display Technology

Displays provide visual information to the briefing creators and the briefing audience. Display devices include monitors (conventional CRT and flat panel designs) and large screen wall displays (LSWDs) such as video projection equipment. Monitors are intended for a small viewing audience, perhaps even a single viewer, while LSWDs is intended for a large viewing audience. LSWDs tend to be viewed at greater distances than monitors. Both types of displays are critical to command center work and BDS functions.

An understanding of display devices requires an understanding of display technology and the human eye. Display devices create an image by activating small, discrete units (either rectangular or square) called picture elements (pixels). These pixels form a grid that makes up the viewable area of a display screen. Groups of pixels within this grid are electronically activated and controlled in terms of value (black and white or color shades) and location on the screen. The combination of pixels within the screen forms the image that we see.

The accuracy of these technical aspects alone does not determine display picture quality. Display quality depends on a certain amount of individual subjectivity as well as several display device variables to be discussed further on.

NOTE: The following excerpt has been extracted from a 1988 DISA DTS Factsheet on Flat Panel Display Systems. The publication gives valuable insight into general display selection criteria; a portion is presented below.

Selecting the Display Best Suited to Your Application

When selecting a specific type of display technology, careful consideration should be given to the application for which the display will be used. The intended application influences many factors by which the capabilities of the equipment must be evaluated. The following guidelines provide a general approach for defining your requirements and selecting a display technology best suited to your application.

Functional Requirements Definition

The first step in the display selection/evaluation process is the identification of display requirements in terms of the information to be displayed, the environment in which the display will be used, and any particular constraints relevant to the selection. As you focus on your application, consider the following questions to define your functional requirements:

- Message. What type of messages will typically be displayed? Will they be numeric, alphanumeric, graphic, or video graphic? How many characters per line and lines per screen are needed? Is punctuation needed? Will you need upper or lower case characters or special symbols? What will be the length of a typical message? Is dynamic or passive presentation required? If so, at what data rates? How much of this information must be displayed simultaneously, for what period of time, and in what format?
- Light. What is the ambient lighting in which the display will be viewed—office lighting or direct sunlight? Will the viewing area be darkened when the display is in use? Are there competing light sources, glare, or reflections which will impinge on the screen?
- Space. What physical mounting dimensions are available for the display? Will the display need to be wall/floor mounted or portable? Is wall panel space at a premium? Is a display with minimum depth needed?
- Viewing. Will the operator be monitoring data at arm's length or across the room from the display? Will there be a large viewing audience? How far away from the screen will the audience be seated? From what angle must the display be viewed (e.g., above, below, or to the sides)?
- Physical environment. In what physical environment will the displays be operated and stored? What are the minimum and maximum temperatures in the environment? Will the display operate in an air-conditioned

computer room or on a loading dock? Will the display be subject to shock and vibration?

Display Design Considerations

Systems Versus Subsystems

Consideration should be given to selecting either a prepackaged, all-inclusive display system with built-in electronics, or a stand-alone unit permitting the design and assembly of subsystem components tailored to your application. Selection of the latter depends on the complexity of the task, production requirements, and availability of personnel expertise. This approach will result in "exact design to application" and, in high-volume applications, may result in reduced material costs. Purchase of a commercial-off-the-shelf subsystem (e.g., numerics, alphanumerics, graphics, bar graphs, symbols) shortens the design cycle, permits rapid redesign, and greatly reduces the chances of design error.

Under certain conditions, creation of a custom display panel may be a more cost-effective approach. Consider, for example, that your application requires a system which displays graphics information. Selection of a system which can be programmed to display fonts and/or symbols in a variety of sizes may result in extensive applications software development costs, special tooling costs, and minimum production volume costs. However, if custom design is required to provide a display with special symbols, it may be more cost effective to purchase a display designed to your application. Some displays (such as LCDs) are readily customized in small quantities because they are manufactured using photographic and screen-printing techniques that do not require special tooling.

Maintenance and Maintenance Training

Consideration should be given to obtaining a maintenance contract (which includes periodic preventive maintenance) or manufacturer-provided maintenance training for operational personnel. Generally, both options are available. In-house training for operational personnel may be provided for an additional cost, but is dependent on the availability of personnel expertise within the command center environment. If maintenance training is being considered, the following topics should be considered before a decision is made.

- Is maintenance training extensive? How many hours of classroom time are required?
- What training is provided as part of the purchase price? Will training be conducted at the installation site?
- If no maintenance training is included in the purchase price, what is the cost of training personnel? Flat fee? Cost per student?
- Can technical manuals be reviewed prior to purchase of the equipment?
- Are service manuals sufficiently detailed to support maintenance by trained operational personnel?
- What is the estimated cost of operation/repair per year per unit?

If a maintenance contract is preferred, the following questions should be considered before a determination is made:

- What is the mean time between failures of electronics, modules, and subsystems?
- What percentage of repairs can be done at the installation site?
- If repairs cannot be made at the installation site, what is the location of the repair facility?
- What is the response time for on-site repair versus expected repair time at the manufacturer's facility?

Operational Training

Many of the maintenance training considerations also apply to operational training, especially with respect to how much training is needed, the cost (if any), where it will be provided, and the adequacy of the users manuals. Users' manuals and related documentation should be reviewed before purchasing the equipment.

NOTE: FACTSHEET 88-6, the source of the material just presented, evaluated several flat-panel displays being used at the time by government and military organizations. Summarized product evaluations are shown in the BDS "yellow pages" of the CCDH.

Source Material

Display quality is, of course, dependent on the source material. Poor quality source material can be improved in a variety of ways by a number of video manipulation devices such as those described in Part 3, under Video Communications Processing. Computer image processing, such as image

enhancement and restoration of LANDSAT and other reconnaissance photographs, would typically be performed by other DoD groups or agencies outside a command center. In these instances, source material quality, not the display device itself, strongly influences perceived picture quality.

Resolution

Display resolution is a measure of the sharpness of detail that a display device can achieve and is usually expressed as a number of pixels per line for a given number of lines, such as 640x480. Perceived resolution can be lower than measured resolution because of picture blurring or other inadequacies of a display device. Generally, the greater the perceived resolution of a display device, the smoother and more accurate the resulting image appears to the human eye. The number of pixels and lines is not the whole story, though, because the size of the pixels and the viewing distance can affect the 'smoothness' of an image.

The target architecture calls for a resolution of 2000 pixels x 2000 lines as the video format of choice. Most current computer-generated graphics and high-resolution images use display formats of 680 pixels x 512 lines, 1024 pixels x 1024 lines, 1280 pixels x 1024 lines, or other high resolution formats. To put this into perspective, a typical facsimile machine can reproduce approximately 200 dots per inch (that works out to 1700 pixels x 2200 lines on a 8-1/2' x 11" page). Although the perception of "broadcast" quality NTSC video is that it can display clear, sharp images, it is unable to depict fine detail. NTSC delivers 350 effective pixels x 480 effective lines. However, the long-established video standard is NTSC and NTSC equipment has a strong customer base, including most command centers. The equipment gap between NTSC and various computer video standards can be somewhat bridged by using various video processing devices that are discussed under Video Communications Processing in Part 3.

Sharpness

Sharpness is the measure of how well the display device can display a transition from a dark area to an adjacent light area without a 'spillover' from one to the other. Sharpness is closely related to resolution.

Brightness

Display device brightness is a measure of the average or overall amount of illumination given off by the device. Adjusted display brightness, for example, allows a display to be viewed under low ambient light conditions.

Contrast Ratio

Contrast ratio expresses the difference in intensity between the lightest and darkest values a display can produce. The perceived maximum contrast ratio for a display device is influenced by ambient light conditions. Therefore, the brighter the ambient light conditions, the less the perceived contrast ratio a display device exhibits.

Character Size

Character size influences legibility of textual information reproduced by a display device. The human eye can resolve a character at distances no more than 200 times the character height. Thus, viewing distance is limited not only by display device quality, but also by the size of the characters displayed.

Display Configurations

Three major technologies presently support display system applications:

- CRTs
- Light valves
- Flat panel designs.

Each technology is discussed below.

Cathode Ray Tube

CRTs are the most highly developed of all the display types mentioned. They are widely used in monitors and projection systems. CRT-based display devices are cost effective and currently provide the best performance/cost ratio of all display types. As the basis behind many video projection systems, CRTs are effective for projecting images up to nine feet wide on a screen

surface. CRT output brightness begins to fall off when displaying image sizes greater than this. Manufacturers of video projection equipment continually strive to increase this output brightness specification, which is expressed in lumens. A lumen is the measure of the intensity of a light source. There are, however, other inherent limitations to CRT-based systems. Current technology limits monitor screen design to approximately fifty diagonal inches. Weight, lack of ruggedness, and high voltage requirements are "built in" factors that exist. Despite these characteristics, CRT displays are capable of displaying all the imagery a command center may generate.

Light Valves

"Light valve" refers to the technique of controlling the amount of projected light with a valve-like mechanism. Light valves operate differently than CRTs and produce superior contrast and brightness qualities when compared to CRT-based systems for LSWDs. Three basic types of light valves are oil film, liquid crystal, and solid-state. The typical source of high-intensity light in light valve systems is a Xenon lamp. As a result, light valves provide the largest and brightest conventional displays available off the shelf today. Their presence, however, is diminishing within the command center community due in part to trade-offs associated with light valve technology. Light valves are considerably more expensive to purchase and maintain than their CRT counterparts. They are very labor intensive to set up, operate, and repair. These trade-offs and their low performance/cost ratio continue to deter their accepted use within command centers.

Flat Panel Designs

Flat panel technologies are not as widely used for display requirements as CRT-based systems. Their inherent weight and power requirement advantages, as well as continued enhancements in brightness and full color capabilities, merit further exploration of this new "breed" of display technology. LED and particularly active matrix LCDs may develop as attractive alternatives to the CRT in the future.

NOTE: The following two paragraphs have been extracted from a previously published DISA DTS Technical Factsheet on Flat Panel Display Systems.

Liquid Crystal Displays

Liquid crystal displays (LCDs) utilize the property of certain long-chain organic molecules to physically orient (polarize) themselves according to an electrical voltage placed across them. Ambient light falling on these polarized crystals will be either reflected back to a viewer, or not, depending upon the polarity. LCDs are common in small consumer products such as hand-held televisions and computer monitors. Currently Sharp Corporation incorporates a ten-inch, full-color, videographics adapter (VGA) -compatible LCD display in a portable PC. LCDs offer the advantage of low cost, but there are also several disadvantages. These include a small viewing angle, relatively low resolution, difficulty in supporting gray scale information, and the present inability to support quality color on a screen larger than ten inches. To correct for poor viewing in dark ambient conditions backlighting is often employed.

LED Displays

A light emitting diode (LED) produces light when an electric current is passed through it. An LED flat panel display screen is a mosaic of such diodes together with amplifiers and circuits that supply current to each diode cell. The resolution of this display depends upon, and increases with, the number of LEDs. While LED systems occupy less space than those using light projection, they have greater power requirements than LCDs, and dissipate greater amounts of heat during operation. LED systems offer very wide viewing angles, constant brightness across the face of the display, and are very reliable.

NOTE: Additional flat panel technologies such as plasma, electroluminescent, and vacuum fluorescent-based systems are also thoroughly discussed in FACTSHEET 88-6. Figure 5-3 contains a comparison of flat panel technologies .

Evaluation of Current Display Technology

Each of the three technologies has merits. Performance in a specific application, however, is highly dependent upon local factors (room size, ambient light, viewing angles, etc.). In general, light valves offer superior contrast and brightness over CRT-based systems. LED and LCD-based systems may be useful in applications where thin design, light weight, and power requirements are of importance.

Technology	Advantages	Disadvantages
Vacuum Fluorescent	Low power consumption High luminance Long life Wide viewing angle	Large numbers of drivers Limited display size
Plasma	Rugged and reliable Large area displays High resolution and contrast Wide viewing angle Limited refresh requirement Graceful failure mode High luminance Readable under all lighting conditions 16 levels of gray scale	High cost (DC panels less costly) Degrades at low pressure Complex drive circuitry High power consumption (for DC displays)
Light-Emitting Diode	High reliability High luminance Multicolor displays Mature technology Wide viewing angle Rugged Low-voltage operation Long operating life	Typically has not been used in large, high-density matrix arrays Dissipation of heat generated by LEDs is necessary for largeLED arrays High power consumption
Electroluminescent	Rugged, reliable, and lightweight Low-cost thin-film process High luminance Modest power Good resolution and contrast Graceful failure mode Five levels of gray scale	Size versus luminance tradeoff Complex drive circuitry Obstacles to full color Power consumption increases with matrix size
Liquid Crystal	Low-voltage battery operation High resolution High contrast potential Full-color active-matrix capability in the near future Graceful failure mode Readable under high ambient lighting conditions Portable	Slow response at low temperature* Backlighting required in low ambient lighting conditions Narrow viewing angle** High resolution and high contrast mutually exclusive**

*An integrated heater provides good response at low temperature.

**Not applicable to active-matrix technique.

Figure 5-3. Comparison of Selected Flat Panel Technologies

Current technologies affect resolution in different ways. In most CRT-based or light valve devices, quite high resolutions can be achieved at low light output levels. As light output is boosted, however, optic light scattering, phosphor decay, and other effects soften the image, thereby reducing display resolution. With LED or LCD displays, which are composed of mechanically fixed pixels, resolution is simply a function of the number of pixel elements per unit of display area. The pixel size defines the granularity of the displayed image.

Future Display Technology

A number of recent developments offer additional promise as candidates for LSWD projection and display system applications in the future:

- Improved CRTs. Driven principally by the demand for better computer monitors, new technology offers hope for improvements in conventional CRT performance and the eventual use of flat CRT displays. Conventional monochrome and color CRT improvements are currently being achieved in resolution and brightness through improved video amplifiers and spot sizes. Additional improvements in conventional CRT performance are being achieved through the use of integrated circuits, better screen phosphors, in-line electron guns, beam-indexing, better deflection yokes, and more rigid shadow masks. Optics manufacturers are currently offering hybrid glass/acrylic lens assemblies with screen-center and corner-focus adjustability. This helps to correct for soft focusing in the corners of a projected image. Digital convergence circuitry is now available to make projector set-up and subsequent drift correction much more streamlined. Automatic convergence is a recent innovation that uses additional hardware and software support to automatically align the red, green, and blue projected images. It will become more standard with CRT based projection systems. Conventional CRTs, however, continue to be bulky and require high input power. These disadvantages have generated interest in flat CRTs. Thus far, flat CRTs have failed to approach conventional CRT performance, and it is expected that LSWD applications that use CRTs will probably be supported by conventional CRTs for the next several years.
- Flat panel displays. Three developments in small display technology may yield eventual applications for LSWD systems:
  - The performance of LCDs, which use reflected light to produce an image, has been limited by viewing angle, resolution, and contrast problems. Backlighting and the use of new metal-insulator-metal (MIM) technology may alleviate these problems. Also, LCD color displays may be available in the future. One such display has already been produced (for a computer monitor application) comparable to color VGA. Displays that use liquid crystals as light shutters are currently very expensive and tend to have a granular, honeycomb-like appearance. If this type of display is produced in quantity using smaller picture dots to obtain better resolution, it may become very suitable for LSWD applications.
  - Electroluminescent panels are active displays that use phosphor pixels as light sources. While their legibility is considerably superior to that of LCD displays, they are relatively expensive and difficult to manufacture. The panels are used in some computer monitor applications.
  - Plasma displays, which operate with a gaseous medium, are also characterized by superior legibility and high cost. To date, only small implementations have been achieved.

Standards

The capability for high-resolution graphics in the current architecture will have a standard of 1280 pixels x 1024 lines, which will be raised to 2000 pixels x 2000 pixels in the target architecture. Motion video will have as its standard in the current architecture an improved definition TV, 525 lines and 60 frames per second instead of 30. In the target architecture, motion video will follow an Advanced NTSC Standard of 1024 lines with 60 frames per second and minimal high-definition TV with 1125 lines and 30 frames per second.

Standards applicable to military LSWDs are contained in MIL-STD-1472C, 2 May 1981. Applications guidance may also be found in MIL-STD-188-318.

BRIEFING CONTROL

Briefings incorporate a full range of information from a variety of media. Future efforts will continue to incorporate presentation techniques that allow the presenter to become more involved and command a presentation directly, as opposed to relying heavily upon a dedicated, behind-the-scenes operator.

The advent of software-based programmable presentation products allows briefing control systems to orchestrate a briefing.

The briefing and display control capability is provided by some configuration of a main control console, local display controllers, audio controls, briefing controls, security controls, and/or podium controls. Products by AMX, Crestron, and others are programmable devices that control presentation products and give a briefer flexibility in presenting information or "running the show." Some software products also provide the ability to control presentation factors such as slide advance and incremental builds of information on the screen; they are discussed in Part 4 under Briefing Preparation.

Computer-aided briefings continue to play an increased role in briefing presentations. The ability to free the computer operator/presenter from the keyboard has sparked a variety of computer remote-control devices. Two classes of such devices are full-function keyboard emulators and programmable hand-held remote controllers. Employing infrared (IR) or radio frequency (RF) transmit/receive methods similar to a home television or stereo remote, briefing personnel are free to move about while they step through a slide presentation. Programmable hand-held remotes such as the Silent Partner from Presentation Electronics and the AirMouse from Selectech, Ltd. allow single or multiple keystroke command combinations to become one-button operations to access on-screen menus from a distance. The majority of these types of devices will function with either DOS or Apple Macintosh computer systems.

BRIEFING AND DISPLAY SUBSYSTEM PRODUCTS, SYSTEMS, AND PROGRAMS

Magnavox MX2116 Flat Panel Display

product type: A fully populated dot matrix AC plasma display screen

function: This system provides video display of alphanumerics, graphics, and composite video.

system description: The Magnavox MX2116 has text capacity, in graphics mode, that is variable depending on the size of characters selected; as a video monitor, all characters and images are displayed. Special features include a portable stand with the capability for wall-mounting; no access is required to the sides or rear of the display. It is ruggedized for fixed, mobile, shipboard, airborne, and submarine applications. The viewing surface is an antireflective EMI shield with TEMPEST options.

users: Under evaluation for surface ship application: used primarily in support of anti-submarine warfare strategic plotting and as submarine combat system tactical display in experiment/demonstration control center.

command center components: A single flat panel unit designed to MIL specifications

acquisition details: The cost of one display unit is $450; five units are $350 each; ten are $300 each; twenty are $225 each. A full warranty is provided for one year, including labor. Delivery is scheduled for 12 to 18 months after receipt of the order.

future growth: unnanounced

reference: Magnavox Electronic Systems Co., 1313 Production Road, Fort Wayne, IN 46808 , (219) 429-5611. See *DISA FACTSHEET 88-6 Flat Panel Display Systems: A Technology Survey* for further reference.

Photonics Systems Nidek PTT-1596-1212-50.8 Flat Panel Display

product type: A fully populated dot matrix AC plasma display screen

function: This product provides alphanumerics, and graphics display.

system description: This flat panel unit has a text capacity of more than 32,000 characters (121 rows of 266 characters). Special features include a touch panel option, user-definable function keys, selectable character sizes, and scrolling reverse video; backlight is available in multiple colors. It is available in ruggedized and militarized versions. The viewing surface is an antireflective EMI shield with TEMPEST options.

users: Previously used as a planning tool by Crisis Action Teams, this device supports windowing, graphics, status updates, and text requirements. Used in support of system development activities for MAC command center upgrade, it serves as flexible "whiteboard" for multiple applications; used to display digital navigation charts for navigation/tactical plotter development.

command center components One plasma display unit designed to MIL specifications.

acquisition details: Each unit costs $50-100K with the lower cost for commercial grade; higher cost for full design to Mil specs. A full warranty of two years, including labor, is provided. The unit will be delivered 6-8 weeks after receipt of order.

future growth: unnanounced

reference: Photonics Systems, Inc., 6967 Wales Road, Northwood, OH, 43619, (419) 666-0762. See *DISA FACTSHEET 88-6 Flat Panel Display Systems: A Technology Survey* for further reference.

Quantum Electronics Model A1920 Flat Panel System

product type: Plasma display with a modular dot matrix

function: Provides alphanumerics and single character graphics display.

system description: The text capacity of this display is 1920 characters (module for 1" letters is 2 lines of 20 characters per line, module for 2" letters is 1 line of 8 characters). Modules may be assembled to maximum display size of 16'X24' or 4,000 characters. Special features include the capability for wall or ceiling mounting or portable stand mounting; windowing capability; blinking; multiple brightness levels; scrolling; and uniform spacing between characters. The viewing surface is an antireflective EMI shield with TEMPEST options.

users: This system can be used as a real-time status display or for status information (e.g. DEFCON, significant events, and timing factors). Two displays can be operated in parallel in a command center application. It has also been used to support weekly management planning meetings.

command center components: A single plasma display; it is not designed to MIL specifications but can be built to customer requirements.

acquisition details: The unit costs $37,000 each and will be delivered 3-4 weeks after receipt of order. A full warranty for 90 days is provided, including labor.

future growth: unannounced

reference: Quantum Electronics, Inc., R.D. 4, Box 6-AAA, Lewistown, PA 17044, (717)242-1132. See *DISA FACTSHEET 88-6 Flat Panel Display Systems: A Technology Survey* for further reference.

Telegenix Model TDS2070

product type: Plasma display with modular line segments

function: This unit provides alphanumerics and single character graphics display.

system description: This system has a text capacity of 1920 characters (the module for 7" letters is 4 lines by 16 columns or 64 characters; the module for 1" characters is 2 lines by 16 columns or 32 characters; the module for 2" characters is 2 lines by 8 columns or 16 characters. Special features of the display include 29 levels of brightness control, four-way scrolling, single character blinking with variable rate, and uniform spacing between characters. The unit may be wall or ceiling mounted or mounted on a portable stand. The viewing surface is an antireflective EMI shield with TEMPEST options.

users: This system has been used by fight controllers to display times (e.g., mission elapsed time) for manned space flight, training, and simulations.

command center components: A single plasma display. It is not designed to MIL specifications but can be built to customer requirements.

acquisition details: The unit costs $25K each and will be delivered 3 months after receipt of the order. It comes with a 2 year warranty on plasma tubes, 1 year on all other components and 90 days on labor.

future growth: unannounced

reference: Telegenix, Inc., 206 Olney Ave., Cherry Hill, NJ 08003, (609)424-5220. See *DISA FACTSHEET 88-6 Flat Panel Display Systems: A Technology Survey* for further reference.

PART 6. "STOVEPIPE" SYSTEMS

INTRODUCTION

The current trend in command center improvement is to enable users to access a wide variety of applications from generic workstations. This trend is a response to the situation that prevailed in command centers in the mid-1980s and may not fully be solved for some time. This situation is characterized by the incorporation into the command center of many different single-purpose systems, each with a distinct user interface, operating system, and set of communication protocols. The lack of integration and interoperability among these systems, as well as the difficulty users may have in learning and adjusting to many different applications and pieces of equipment, is a significant problem in command centers. The predicament of command center staff who must cope with several of these systems on a daily basis is illustrated in Figure 6-1.

The MROC process places major emphasis on the replacement of these systems, and on ensuring that the new systems genuinely represent an improvement. Although stovepipe systems will be a fact of life in command centers for the foreseeable future, they are separated and discussed in this section due to the special conditions surrounding their development and use.

"STOVEPIPE" SYSTEM DESCRIPTIONS

Improved Emergency Message Automated Transmission System (IEMATS)

traffic: Secure data

function: IEMATS allows rapid composition, review, release, receipt and acknowledgment of EAMs.

system description: IEMATS provides the Joint Staff and SIOP CINCs with automated EAM capability through AUTODIN and AFSATCOM. The IEMATS allows the operator to call up preformatted messages and insert data, or compose a new message. The operator can use menus to simplify message composition. IEMATS sends the EAMs to all addresses. If the EAM is not acknowledged by all addressees, IEMATS will repeat the message for a set amount of time. The sending operator has a lighted console showing which sites have acknowledged the message.

users: The Joint Staff and SIOP-responsible CINCs

command center components: *One master and one slave IEMATS terminal* that each consist of a terminal processing unit, message storage devices, a display screen a message card reader, and printer. The message status visual display indicates EAM acknowledgment.

future growth: IEMATS will be replaced by the Automated EAM Processing and Dissemination System (AEPDS).

reference: TBD

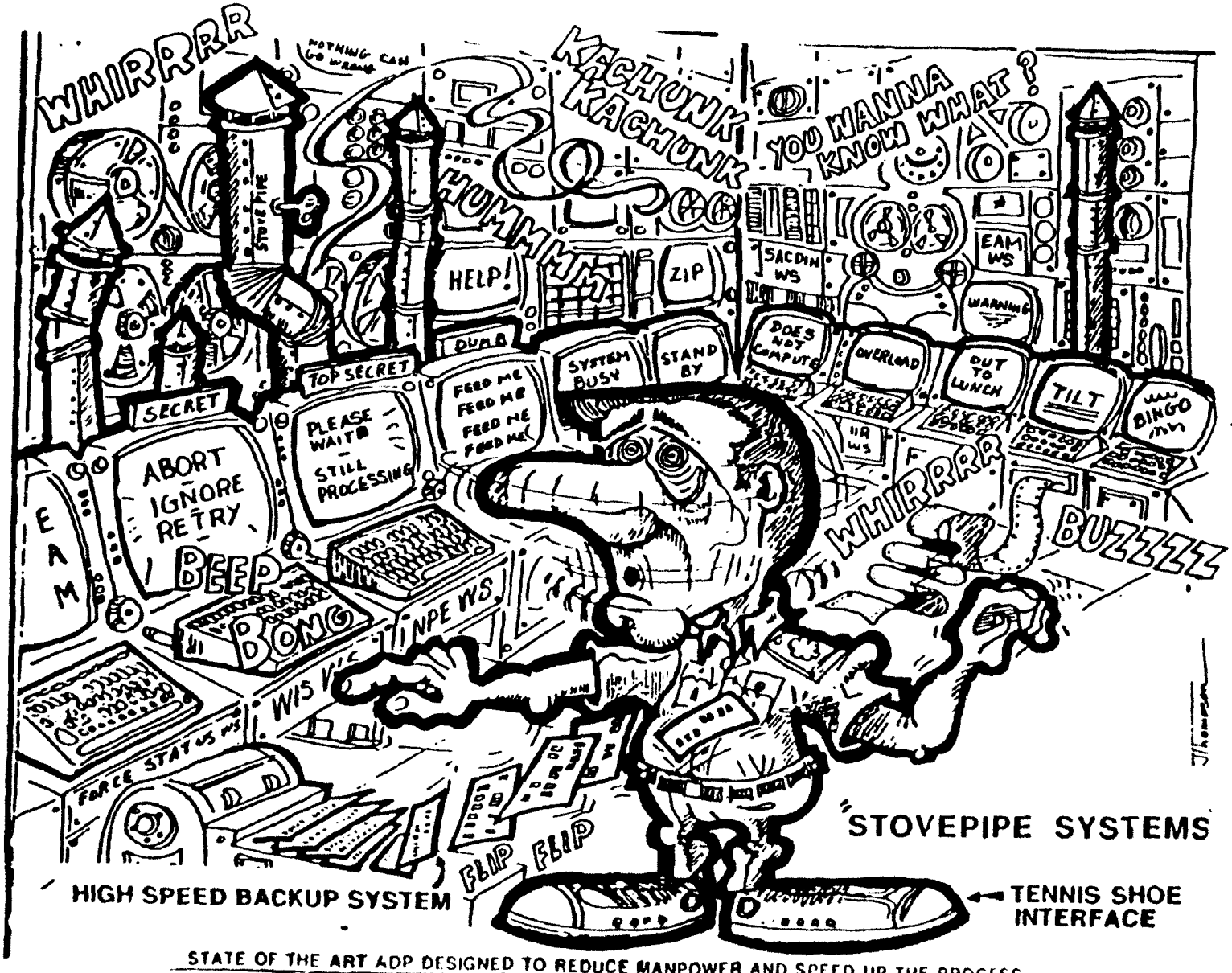


Figure 6-1. Stovepipe Systems

Survivable Communications Integrated System (SCIS)

traffic: Secure survivable data

function: SCIS provides survivable missile warning communications processing.

system description: The SCIS is a front-end message processor for all ballistic missile warning communications. At the sensor sites, SCIS properly formats messages and transmits them to the correlation centers and the forward users. At the correlation centers, messages from a variety of sensors are correlated, reformatted, and forwarded to the forward users. At the forward user sites, SCIS removes duplicate messages, verifies and validates the messages, and passes the messages to the Processing and Display Subsystem (PDS). All links between SCIS units are accomplished with at least two communications paths, for increased survivability.

users: Ballistic missile sensor sites, the NMCC, ANMCC, SAC, US Atlantic Command, US Pacific Command, US European Command, CMAFB, and Offutt Processing and Correllation Center (OPCC)

command center components: The forward user unit will be installed at the command centers and consists of processing and storage devices in two standard equipment racks; two terminals, each with terminal box, display screen and keyboard; an alarm; and printer. At CMAFB and OPCC, which serve as the correlation centers, there will be additional processing equipment.

future growth: SCIS is still in development.

reference: TBD

Automated EAM Processing and Dissemination System (AEPDS)

traffic: Secure data

function: AEPDS allows rapid composition, review, release, receipt and acknowledgment of EAMs.

system description: AEPDS will provide the Joint Staff and SIOP CINCs with automated EAM capability through AUTODIN and AFSATCOM and numerous other communications media. AEPDS allows all EAM release and receipt at a given site to be performed from one automated console. AEPDS uses communications interface modules (CIM) that can be programmed to interface with most EAM communications media. With the correct CIM's, each site can customize AEPDS for its needs.

AEPDS provides the operator with blank, preformatted messages, or with menus to prompt during message composition.

users: The Joint Staff and SIOP CINCs.

command center components: Processing and interface equipment housed in one standard equipment rack; a number of fixed command terminals (FCT) determined by the site; two portable command terminals (PCT); and a number of printers determined by the site.

future growth: AEPDS is still in development. It will replace the JEMATS

reference: TBD

PART 7. FACILITIES

INTRODUCTION

Part 7 contains relevant information about all the many systems that provide for such capabilities as building security, space environmental conditions, or basic building construction components. The information indicates how those systems should be considered as holistic capabilities that enable command center personnel to optimally perform their activities efficiently and effectively. Building component systems are those that enable a facility to optimally support a command center, even though such systems do not directly perform a specific mission function. Part 7 is organized around eight categories of facility subsystems:

- Functional components
- Building security
- Interior finishes
- Acoustics
- Lighting
- Electrical power
- Heating, ventilation, and air conditioning
- Fire protection and life safety.

Standards

Current and emerging standards have been identified for several facility subsystem capabilities and are discussed in the sections covering each capability.

FUNCTIONAL COMPONENTS

Interior construction functional component subsystems include workstation furnishings and cable accessibility units. The furnishings of each space should be appropriate to its mission function. The furnishings that make up the action officer (AO) workstations are the primary facility support subsystem that impacts the successful completion of these mission functions. The five objectives for optimal furnishings subsystem support are:

- Maximum worksurface area available in relation to floor area
- Modular modifiability
- Functional flexibility
- Structural stability
- Optimal occupant choice options.

The only way to achieve the objectives with commercial-off-the-shelf components is to use "Systems Furniture," which will be illustrated in Figure 7-6.

Also, almost all AO workstations now require extensive, evolving communication and information processing equipment to successfully complete the mission functions. In order to over time maintain the desired workstation conditions (flexibility/modifiability/choice) the power and signal cabling to the equipment must be also optimally accessible. Therefore, cable and duct accessibility subsystems are the companion primary facility-related functional components.

Furnishings

Furnishings provide the work-surfaces, seating, and storage in any facility. They organize the work-place. The distribution of furnishings throughout a facility serves to organize the activities that take place within that facility. Furnishings accommodate the user of a facility by putting work materials and equipment in a usable, comfortable configuration. Furnishings should serve this function equally well for a succession of users, and should, therefore, be adjustable to accommodate expected variations. Recently developed furnishing systems incorporate utility-distribution—power, lighting, interior finish, and HVAC. As a result, the selection of a furnishing system must be made in concert with the selection of all other systems.

Ergonomics is the study of the relationship between people and their work. It seeks accommodation of the user of a work space, to achieve optimum job performance. Consideration of ergonomic factors in command center furnishings can aid the successful realization of the facility's mission. From this approach, two aspects of the furnishing system should be considered: the individual work-station and seating.

The Individual Work-Station

The ergonomic approach to work-station design requires a coordinated view of all elements of the work-station.

One must consider the interaction between task and environmental components, and among the systems elements—including display, worksurfaces, and seating. The interactions at the work-station take place within what has come to be known as the work-envelope—defined as that area within which a worker can comfortably and efficiently see all necessary data displays, and carry out the work of the station.

The diagrams (Figures 7-1 through 7-4) depict the work envelope. Dimensions are in inches; they describe spaces and sizes appropriate for 95 percent of the user population—from the 2.5 percentile to the 97.5 percentile. The middle value shown in the diagram is at the 50th percentile. The dimensions are drawn from studies of military populations; they are relevant to design of command center furnishings.

The diagrams show a wide range of dimensions. Seated-viewing-height ranges from 26.3 inches to 33.9 inches (a 7.6-inch range). Maximum-arm-reach ranges from 23.9 inches to 7.3 inches (a 7.3-inch range).

The fit of the operator to the equipment becomes critical as the time-on-task and importance-of-task increase. Here, it is useful to design the workstation for the most strenuous case: that is, intensive and long use of display surfaces and operational equipment, with little change in posture and task.

If equipment—seat, footrest, writing surface, data entry surface, displays—cannot be adjusted to user preferences, the user's working posture is forced to adjust to the equipment dimensions, probably resulting in rapid fatigue and poor job performance. Equipment, then, should be adjustable to variations in size and postural preferences. These adjustments should be easy to make, preferably from a seated position.

At the workstation, the dimensions of the work-envelope should reflect the capabilities, limitations, dimensions, and preference of the user of the station

Displays must be located at the proper distance and in the right direction (elevation and angulation) with respect to the human eye—a critical consideration. Usually, there is a preference for an inclination of the line of sight below the horizontal.

Proper viewing distance depends on the visual ability of the user—who may wear eyeglasses or other visual correction. Regular reading glasses are not suitable for prolonged work with visual displays.

Worksurfaces, including writing tables, should be located at the preferred height and distance for ease of manipulation, support of the forearm, and convenience with respect to seeing the target. In providing leg room for the seated operator, particular attention should be given to space for the knees and feet—with space for variation in posture. Reduction in height, width or depth of leg room results in confined postures, and in uncomfortable or even unhealthy body positions. Recommended dimensions for leg room are derived from human body dimensions, taking into account footwear and the use of foot-operated controls and footrests.

Support for palm, hand, wrist, and arm is desirable for long-term operation of keyboards in VDT work-places. While the proper locations and dimensions of armrests depend on the location of the elbow and forearm of the user, no recommendations have been developed regarding support of the wrist, hand, and palm. The suitability of such support may depend on the keyboard and the keying task.

The keyboard should be detachable from the video terminal so that it can be located for convenience and preference of the individual operator.

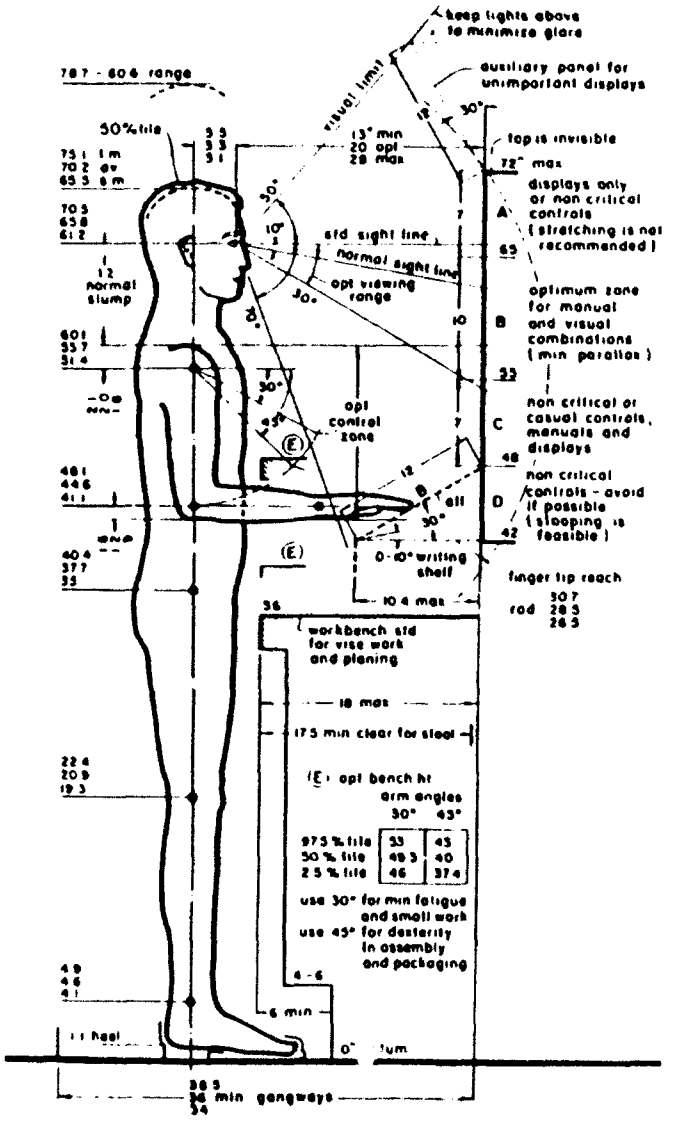


Figure 7-1. Average Male Standing Work Envelope

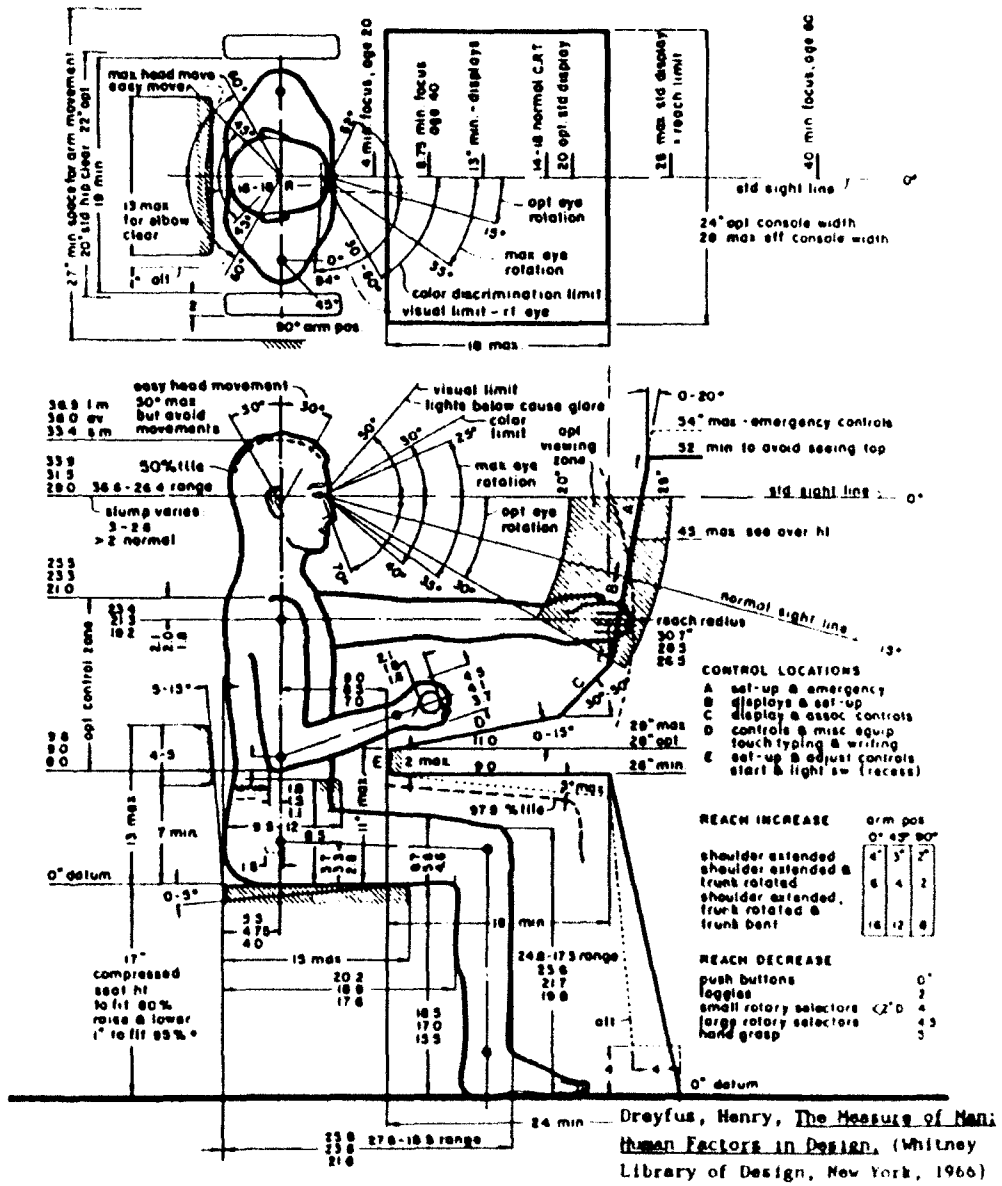


Figure 7-2. Average Male Seated Work Envelope

Dreyfus, Henry, The Measure of Man; Human Factors in Design. (Whitney Library of Design, New York, 1966)

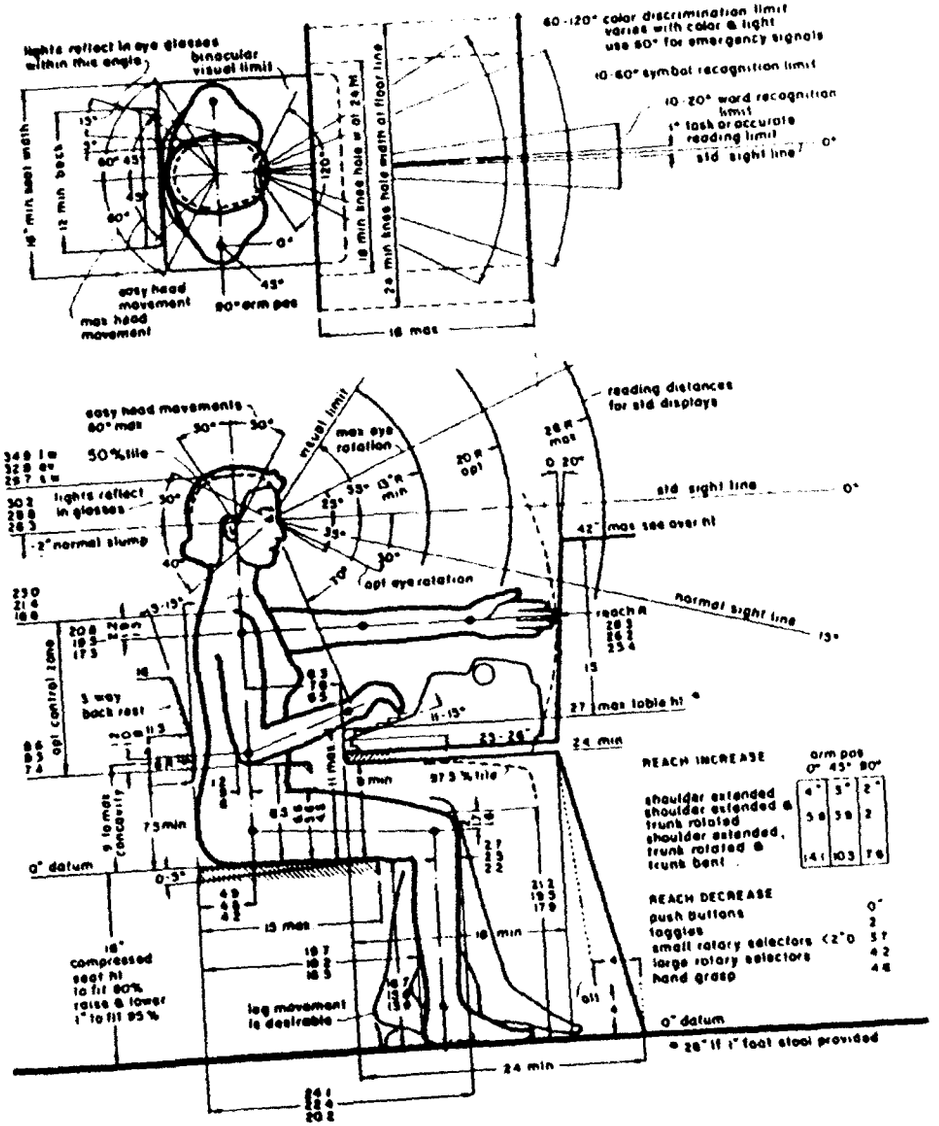


Figure 7-3. Average Female Standing Work Envelope

Dreyfus, Henry, The Measure of Man: Human Factors in Design. (Whitney Library of Design, New York, 1966)

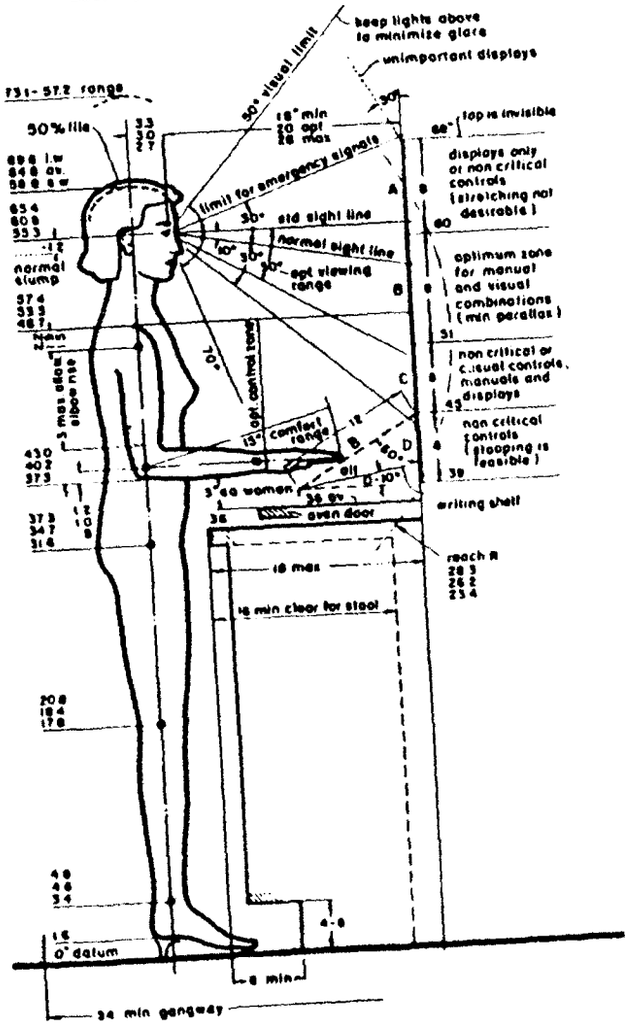


Figure 7-4. Average Female Seated Work Envelope

Seating

Seating is the most critical element in the furnishings systems. The seat-pan supports the body weight; depending on the body posture (forward, central, or backward body position), 25 to 100 percent of the body weight is supported by the seat-pan.

A properly-designed backrest can support some of the body weight. Its main function is to provide trunk stabilization, and to allow relaxation of the trunk muscles. Therefore, the backrest should provide firm, not weak support.

In providing firm support to the user, seating should meet certain criteria.

- The edge of a chair should be rounded off—in what is often called a scroll edge or waterfall cushion—in order to avoid restricting the blood flow in the underpart of the thighs.
- The seat cushion should have only light padding so the buttocks can change pressure areas easily. If it is too soft, it puts upward pressure under the thighs and hip bones, pinching the underside of the socket joint.
- The backrests should be high enough to allow for relaxing, at least high enough to hit the lower few inches of the shoulder girdle, giving the arm a stable base against which to move. Support for the lumbar vertebrae should be provided, helping the back to hold a slight forward arch. Just above the surface of the seat, the backrest should be either left open or so concave that the ischium can be rotated backwards without hindrance. This also allows for air circulation.
- The seat height should be adjustable, with 6 to 9-1/2 inches of vertical movement.
- A footrest should be provided. This accommodates short people and improves the angle of the foot in repose.
- A headrest is useful if the chair reclines. However, large rolls that push the head forward are worse than no headrest at all.
- There should be some mechanism for inclining the back and seat, to rest back muscles.

An important consideration is the ease with which adjustments can be performed. Adjustments will not be performed properly, if at all, if the adjusting is difficult or time-consuming. Easy adjustability allows the user to change the posture during the work day, alleviating problems from sustained positions and improving alertness and productivity.

Furnishing Types

A furnishing system can be categorized as conventional, systems, or modular.

Conventional furnishing, as shown in Figure 7-5, includes standard desks, tables, file cabinets, and shelving, all generally familiar.

Systems furnishing, as shown in Figure 7-6, is built around a central support structure such as partitions or aluminum channel sections. Components such as worksurfaces, storage bins, drawers, shelving, and lighting are suspended from this support.

Modular furnishing, as shown in Figure 7-7, uses partitions as space-dividing elements. It uses standard desks or other components and/or systems components suspended from these elements. This category offers some of the benefits of both conventional and systems furnishing, and is coming into more common use.

The selection of a furnishing system can be made on the basis of flexibility, reconfiguration, integration of utilities, efficiency of space, privacy level, and project scale. (See Figure 7-8 for an evaluation of the different types of furnishings.)

Flexibility

Flexibility describes the ease with which a work-station can be rearranged to accommodate varying needs. Changes may occur in the number and configuration of worksurfaces, in the addition of storage capacity, or in the accommodation of additional workers.

Reconfiguration

Ease of reconfiguration addresses the ability to rearrange an entire office layout. This has implications for the ease with which an organization may be restructured. Ease in reconfiguring a facility allows the restructuring of office organization as teams grow or shrink, or with changing tasks or needs.

- Space divided by furnishing or by fixed or moveable partitions
- Work surfaces and storage provided by free standing components
- Overhead storage may be provided by carrel units
- Task lighting may be integrated with carrel units

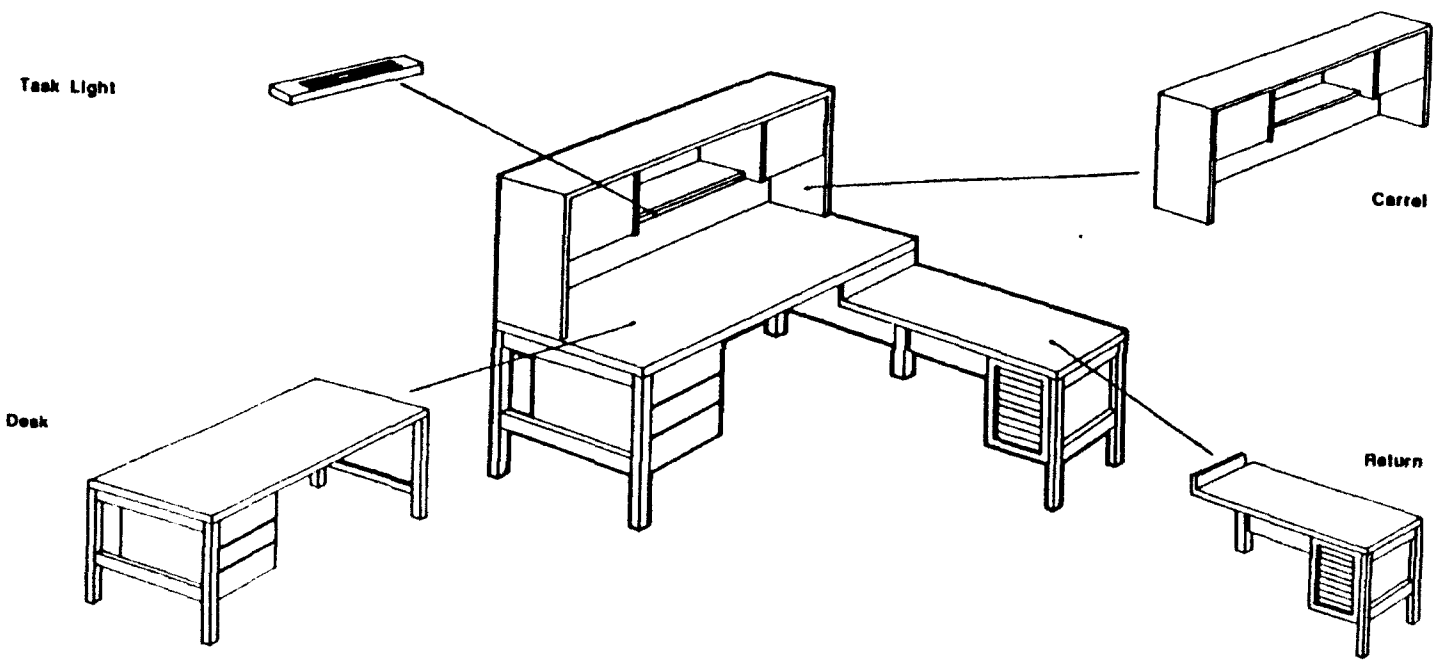


Figure 7-5. Conventional Furnishing Components

- Space divided by office partitions
- Panel heights range from 42" to 80"
- Work surfaces entirely supported by panel or beam system
- Storage units suspended below work surfaces. Overhead storage hung from panel or beam support
- Ambient and task lighting provided as integrated furnishing components

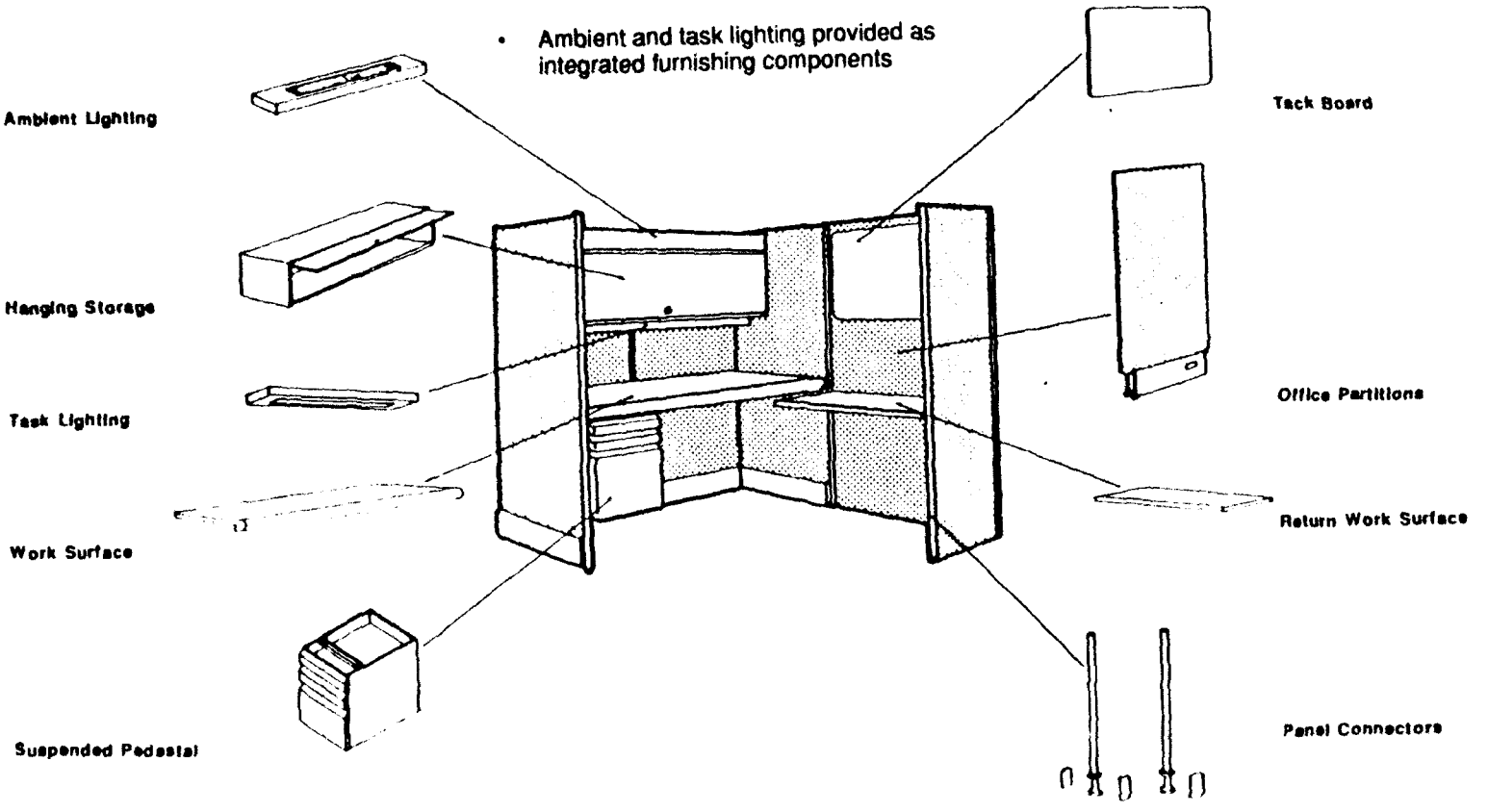


Figure 7-6. Systems Furnishing Components

- Space division by office partitions
- Panels available in 42" to 80" heights
- Work surfaces are free standing or partially supported by panels
- Storage units are free standing. Overhead storage hung from panel support
- Ambient and task lighting provided as integrated furnishing components

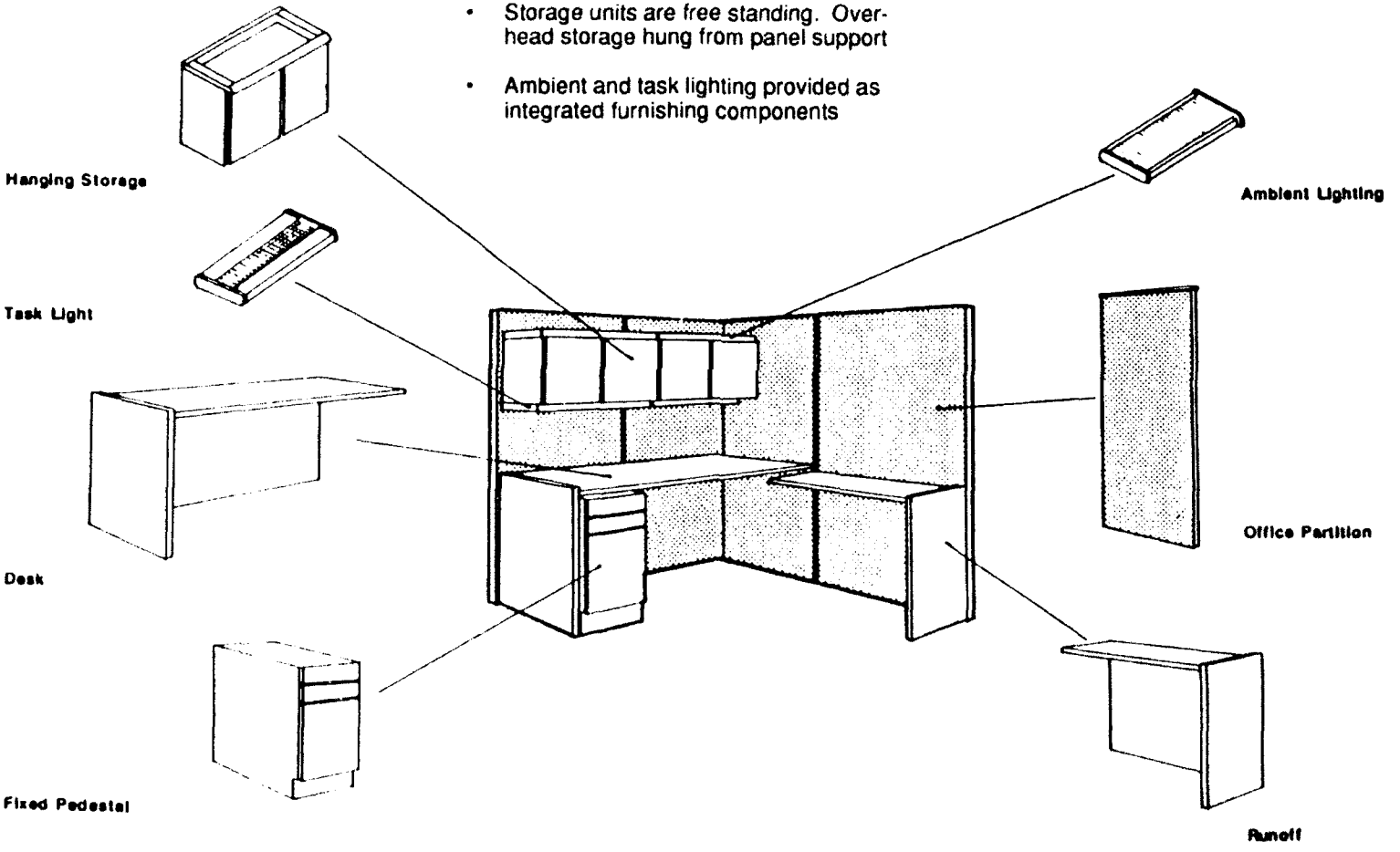


Figure 7-7. Modular Furnishing Components

	Systems	Modular	Conventional
Flexibility	Maximum flexibility, any component may be moved or changed. Work surface and storage heights may be easily adjusted	Best flexibility of storage components. These may be easily moved or changed. Worksurfaces are less flexible than for systems furnishing	Least flexible, units are fixed and not easily changed
Reconfiguration	Some panel layouts can be reconfigured only by moving an entire office, this may be difficult and expensive	May use fewer panels and so allow for easier reconfiguration	Fairly easy, may be limited by any fixed partitioning which may be required
Integration of Services	May serve as sole distribution system for electrical and data lines. Some manufacturers integrate air handling	Similar to systems furniture though limited by fewer number of panels	Generally poor, though some manufacturers offer this capability
Efficiency of Space	Maximum efficiency of space use. Allows most comfortable work-station in the least amount of space. Makes use of vertical space for storage	Similar to systems furniture, though less efficient	Inefficient, does not use vertical space, requires floor supported storage
Privacy Level	Allows for maximum density with visual privacy and some acoustic privacy	Similar to systems furniture	Allows for best visual and acoustic privacy as used in private offices. Allows for contact between people in an open office
Project Scale	Very expensive. Economic advantages are best realized in large projects. Smaller projects may be uneconomical	Expensive, may not be economical for small project	May not be economical for large projects as it does not make use of space as efficiently as other furnishing types. Best for small scale planning

Figure 7-8. Comparison Evaluation of Types of Furnishings

Integration of Services Utilities

This is the integration of building utilities—electrical power distribution, phone lines, data processing lines, lighting—into the furnishing system. Most systems integrate electrical distribution. Some offer three separate circuits that may be selected by the user at the power outlet, allowing sensitive equipment to be isolated from less demanding fixtures and avoiding the generation of line surges or other distortions in the power supply. Further variety is available in the number of phone and data lines and the degree to which these may be isolated from each other.

Efficiency of Space

Efficiency of space derives from the amount of floor space per worker required by each system. Systems furnishing provides storage suspended above work-surfaces, using space in a vertical as well as a horizontal direction. The use of furnishing-partitions allows workers to be placed closer together without a sense of crowding. As a result, systems furnishing is inherently more efficient in use of space than is conventional furnishing. This advantage, however, must be balanced against other criteria.

Privacy Level

The privacy level is a product of the degree to which workers are isolated from each other. Isolation may be either visual or auditory or both. Furnishing systems usually allow visual and auditory contact between work stations. Privacy can be provided, to varying degrees, by partitions. These may be half-height, to provide visual isolation for seated personnel, or full-height, to provide visual and acoustic isolation. They may be glass to allow visual contact. For further information, see Acoustics.

Project Scale

Project scale, the amount of furnishings to be provided, has considerable effect on the economic feasibility of each furnishing type. Systems furnishing is usually much more expensive than conventional furnishing. Conventional furnishing is often selected for smaller-scale installations. Modular furnishing is similar to systems furnishing in this regard, but it has the advantage of allowing long-term planning and integration of future furnishing.

For command center applications, systems furnishing best provides for required flexibility and adjustability. It provides a structural base—of partitions or beam supports—that can support a wide range of worksurfaces, storage components, and equipment. This system allows a flexible configuration of these elements—allowing reconfiguration over time to respond to changing technologies. Systems furnishing manufacturers offer a broad range of component parts to meet most work-station requirements. Where highly specialized pieces of equipment are needed, it is possible to customize support hardware to integrate this equipment with a systems furnishing configuration.

Hexagonal Geometry for Systems Furniture Modules

Research recently completed by the Army Corps of Engineers in the layout of systems furniture leads to a recommendation of layouts with a hexagonal geometry, as shown in Figure 7-9. This hexagonal configuration has been demonstrated to be beneficial for a number of reasons:

1. Hexagonal modules accommodate growth and changing occupancy demands without requiring reconfiguration of the system layout. Changes usually occur internal to the module. Unlike a rectilinear configuration, hexagonal modules can be easily reconfigured to accommodate 1, 2 or 3 users comfortably, without the need to rearrange panels.

2. There is actually little flexibility in a rectangular layout of system furnishings, once all wiring, cabling, utilities, and telephones are in place. Workstations that are tied to adjacent workstations prohibit modification and change in the layout. In practice, only critically important changes are finally made. In contrast, a change in a task performed in a hexagonal work-station often can be accommodated within the hexagonal module, without change in configuration. It is not necessary to enter into a difficult redesign effort to be responsive to changing user needs and requirements.

3. The hexagonal geometry, when properly designed, easily permits the organization of "team" work. Hexagonal layouts can be grouped or re-grouped into changing sets of two or three modules. Teams that consist of 4 to 6 individuals may work adjacent to each other for the duration of a project, then reorganize as future demands require. The opening and closing of modules occurs very easily.

4. Hexagonal layouts create niches, allowing for visual relief. The "tunnel" effect often created with rectilinear layouts is eliminated with this geometry. In addition, panels aligned in long, straight runs seldom stay

aligned, presenting an appearance of disarray. The hexagonal layouts eliminate this problem and greatly improve the aesthetics of the space.

5. Hexagonal layouts will result in a net savings of approximately 25 percent of the required panel purchase. This savings results in part from the grouping of employees into pairs rather than placing each employee an individual cubicle.

6. One of the most important advantages of hexagonal layouts for both the vendor and the buyer is the ability to standardize the panel selection. This layout calls for the use of a single panel size, 3 feet wide, and thus allows componentry to be interchangeable throughout a facility and greatly simplifies installation.

7. Hexagonal workstations permit the exploitation of an important advantage of post systems: their ability to be "double-loaded" at the post connector when the system is configured at 120-degree angles. This 120-degree angle affords the user an opportunity to greatly increase the amount of componentry placed at each work-station.

8. Hexagonal workstations are commonly perceived as being significantly larger than rectangular cubicles of comparable size per work-station. Hexagonal workstations have the benefit of every wall or panel seeming to slant away from the occupant. This provides the user with the perception of spaciousness and accommodation. Hexagonal modules often appear to be like "private offices," rather than cubicles that may be perceived as demeaning or physically restraining. Sharing a hexagonal module does not appear to significantly alter this perception.

9. Hexagonal workstations, when collectively designed for a given area, will make active use of the corridors and circulation paths. Niches can be designed to accommodate copy machines, display boards, and storage requirements.

10. Since all modules are dimensionally equivalent, changes to the furniture layout do not result in discarded furniture. Every system component may be reused at any other location throughout the facility. Standardization and uniformity will actually result in flexibility.

Standardizing modules in hexagonal configurations can provide a facility with a stable set of flexible modules that can evolve individually over time. Further, this evolution can come at the initiation of the users of the system. Many of the generic systems furniture configurations shown in CCDH Volume 2 were designed using the hexagonal geometry. Each functional space description includes a 2-dimensional and a 3-dimensional drawing of typical hexagonal layouts. See Spaces C-9 Special Operations Center, C-11 Battle Staff Support Center, and C-19 Logistics Coordination Center for three different examples.

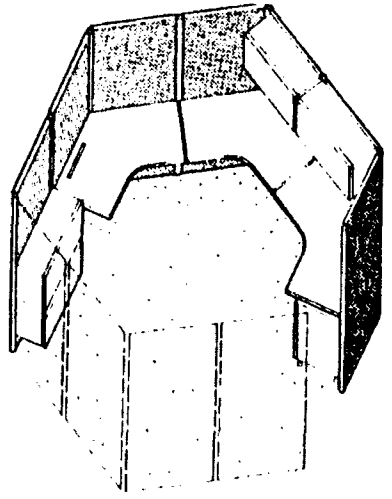


Figure 7-9. 90 SF Hexagonal Module

Evaluation of Furnishing Systems

Furnishing systems are available at a wide range of quality levels. The quality of a furnishing system can be evaluated on the basis of technical capability and performance; and service capability and performance. Technical capability and performance includes maintenance, wire/cable management, workmanship, operating parts, system flexibility, and reconfiguration. Service capability and performance includes product management services, prior installation record, design/layout support, end-user orientation/training, and parts turn-around.

Evaluation based on technical capability and performance:

- Workmanship: panels and components should fit properly when in position. There should be good uniformity in product quality. The system should be simple to work with and have well-designed components free from manufacturing defects.
- Operating parts: all doors, drawers and components should work smoothly without binding or racking. Operable units should be silent, durable, and of good quality.
- System flexibility: installation of the furnishing system should require a minimum number of component types and sizes; reconfiguration of individual workstations and workstation clusters should be accomplished with a good component re-use/augmentation ratio.
- Reconfiguration: the system should be easily reconfigurable by an in-house staff, following some basic and simple instruction. Take-down and set-up of components should be effected without the need for special tools.

Evaluation based on service capability and performance:

- Product-management services: a full range of product-management services should be readily available from the manufacturer. The use of product manuals and tools should require minimal training.
- Prior installation record: delivery dates should have been met, with installations completed on schedule, as specified, and within budget.
- Design/layout support: the manufacturer should provide excellent in-house design services, with the customary level of coordination and participation.
- End-user training/orientation: the manufacturer should provide beneficial orientation and training sessions. User-acclimation and productivity-resumption times should be minimal.
- Parts turn-around: a single-source procurement of additional components should be possible, with accelerated order processing and delivery available.

Accessibility

Floors and ceilings are the two interior construction subsystems that are the primary providers of the extensive cable and duct accessibility required in command center operational spaces. The selection and evaluation of the systems designed to provide cable and duct accessibility must meet the following requirements:

- Accommodate modifications with minimal (or no) downtime for the operations.
- Integrate the cable and duct components with the other relevant subsystems—such as ambient lighting and fire suppression.
- Minimize sound transmission between spaces.
- Maintain life safety and fire protection standards.

Floor Access

To perform the critical mission it has been assigned, a command center must receive or access information, analyze information, form solutions, formulate decisions, and finally, distribute or communicate those decisions to others responsible for action. This must be done quickly, efficiently, and reliably. This has required the development of electronic information systems, contributing significantly to the scope of the mechanical, electrical, and communications systems that must be integrated into a facility. Without a careful strategy for system installation, maintenance and change, the efficiency, flexibility, safety, and economic feasibility of command center operations can be jeopardized.

A viable strategy must incorporate architectural, structural, mechanical, and electrical considerations. The key to this strategy is ready access to the

building utilities systems, and six access alternatives, singly or in combination, are available to provide it. (Manufacturers also offer options or products within these alternatives.) These alternatives—for access to building utilities—are the poke-through method, raised access floor, flexible plug-in wiring, cellular floor, under floor duct, and flat conductor cable.

Poke-Through Method

The poke-through method illustrated in Figure 7-10 uses fire-rated fittings and floor-outlet assemblies. Outlets are installed either by core-drilling the concrete floor slab, or by activating preset sleeves installed in the slab. To maintain the fire rating of the concrete floor, penetration is limited to one outlet per 65 square feet. Poke-through usually is employed with a traditional distribution system, employing conduit and junction boxes.

This method provides adequate flexibility. The outlets, however, standing 3-4 inches above the floor, must be placed where they are accessible but not hazardous. The major limitation of this system is lack of mobility. All changes, including relocation and expansion, require an electrician. To maintain the fire-rating and the structural integrity of the flooring system, rules on the number of holes permitted in the floor must be strictly observed. The system also prevents certain special-shielding requirements.

Raised Access-Floor

A raised access-floor, as shown in Figure 7-11, consists of panels—of durable and stable construction—supported on pedestals 4 to 12 inches above the structural floor. The panels—typically 2 feet square—can be removed to give convenient access to the floor plenum. Panels usually are covered with carpet tiles. Outlets—usually flush with the floor surface—can be installed in a panel cutout at any location.

Distribution of service is provided through the floor plenum. Power service may be enclosed in hard-wire or flexible conduit. When the floor is not used as a plenum for the HVAC system, electronic and communication services can be installed without raceways. Because an access floor cannot provide for ceiling lighting, supplementary hard-wire or flexible conduit for this is required in the ceiling plenum. Task lighting, however, can be provided from the plenum, from the same system used for power delivery. Electronic and communication services normally are delivered through the floor plenum.

Advantages of an access-floor system include:

- Total flexibility in the placement of system feeds and outlets.

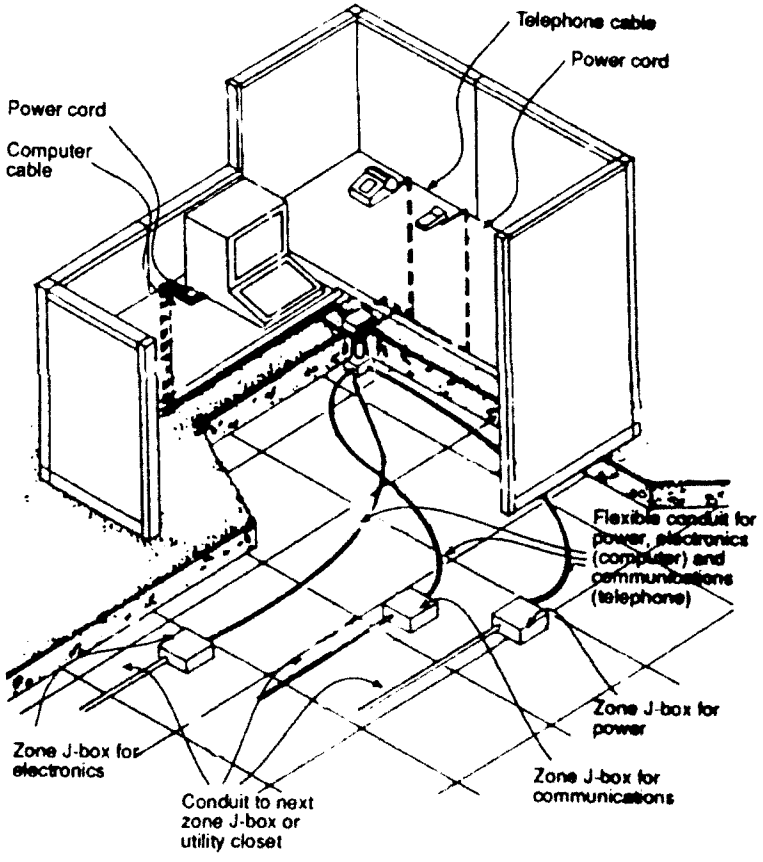


Figure 7-10. Poke-Through Hardwire System

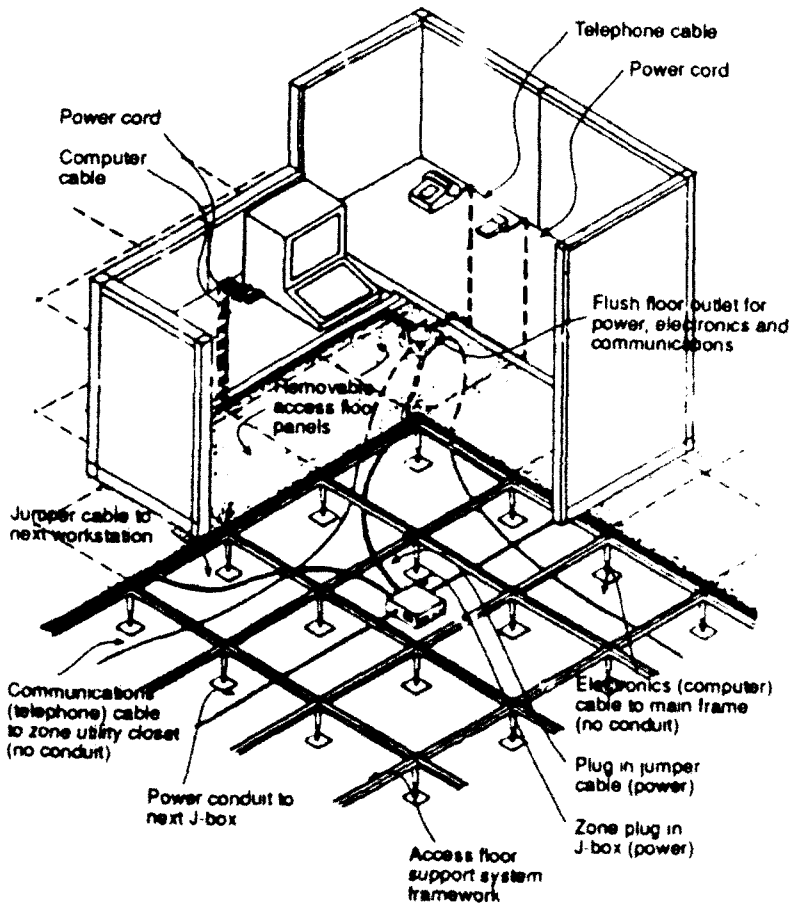


Figure 7-11. Raised-Access Floor System

- Great flexibility in the location of furniture and equipment.
- Virtually unlimited capacity to expand the power, electronic, and communication service. Changes can be made simply by removing the floor panels and connecting or routing new service.
- Placement of HVAC equipment in the plenum space. This can work very well in meeting the cooling requirements of large pieces of communication and data processing equipment.
- Economy in the reduction of concrete floor slab finishing.

While the access-floor advantages are attractive, there are some disadvantages as well. These include:

- The inherent instability of the flooring system, due to the lack of flooring mass.
- The reduction in floor-to-ceiling height, or the need to lower the area in which the access floor is to be placed.
- The lack of watertight integrity of the floor. Care must be taken so that water or spilled liquids cannot leak or drip into the plenum onto wiring

Fabrication and installation of a raised access-floor system should take into account a number of specific considerations. In new-building construction, consider installing the computer-room floor 18 to 24 inches lower than the normal building floor. The raised floor can then be installed flush with the normal building floor, eliminating the need for ramps.

The subfloor (under the raised floor) should be equipped with one or more devices to warn of the presence of water—i.e., from a broken pipe or hose. A float-operated switch controlling both an audible alarm and a sump pump is recommended.

When the space below the raised floor is to be used as an air plenum, air leakage through the joints between panels and around the perimeter of the floor system should not exceed 0.1 cubic feet of air per minute per linear foot of joint, subjected to a 0.5-inch water gage positive pressure in the plenum.

The access-floor system should be grounded for safety hazards and static suppression. Total system-resistance from the wearing surface of the floor to the ground connection—as measured on the completed installation—must be between 5 x 10 ohms and 2 x 10 ohms. There can be no exposed metal at the wearing surface of the floor. Ground connection should be made to the power equipment ground grid.

The floor system should be stringer type.

All components of the floor system other than the wearing surface and wood core panels should be of noncombustible construction. Wood core panels should have a flame spread rating of 25 or less when tested in accordance with ASTM E 84.

Stringers should be made of extruded aluminum or zinc-coated steel, should interlock or key with the pedestal heads, and should be rigid enough to resist denting or deforming with rough handling. Interfacing between panel and stringer should provide sound-deadening, positive electrical grounding of all metal components, and complete plenum sealing.

Pedestal Requirements

Pedestals should be able to carry a 5000-pound axial load without permanent deformation.

Each pedestal should be capable of at least a 2-inch vertical adjustment, with a means provided for locking this adjustment. Pedestal bases should provide a nominal bearing area of 16 square inches. Leveling features should allow for overall floor adjustment to within 0.10 inch.

Pedestal adhesive, when applied in accordance with the manufacturer's instructions, should secure a pedestal in place with bonding strong enough to resist an overturning force of 1000 inch-pounds, with the force applied to the top of the pedestal.

Panel Requirements

Panels should be 24 x 24 inches except for edge panels. Finished panels should be within a 0.015 inch tolerance of panel nominal size, and should be square within a tolerance of 0.020 inch. Panels should be chemically cleaned and bonded, and given a baked-enamel finish standard with the floor manufacturer. Panels should be aluminum, steel, metal-clad wood core, or composite.

Aluminum panels should be die-cast.

Steel panels should be die-form construction.

Metal-clad wood cores should have a core of particle board conforming to Com. Std. CS 236, type 1, grade B, class 2, or plywood conforming to Prod. Std. PS 1, EXT-DFPA-C-C, not less than 1 inch thick. They should be faced on both sides with structurally bonded zinc-coated steel shells and sealed on all four edges with zinc-coated steel or extruded aluminum. Steel should be no lighter than 24-gage.

Composite panels are steel or metal pans filled with lightweight concrete. The composite panel is much less susceptible to the deflection and instability evident in most raised access-floor systems.

Floor covering should be bonded to panels before delivery to the site. Bonds should be strong enough to permit handling with a lifting device, and should withstand moving caster loads up to 1000 pounds without separation of the covering from the panel.

In new construction, all concrete floor-slabs below raised floors must be treated with hardener. In existing buildings, an exposed concrete floor-slab should be sealed if the enclosed area is to be used as a plenum. Unsealed concrete slabs continue to lose cement fines as a concrete dust that will be drawn up into the C-E equipment with the supply air. Where a raised floor is already installed over an existing exposed slab, use of a water-based, pigmented epoxy sealer can enable workers to see the floor they have covered.

Flexible Plug-In Wiring

Flexible plug-in wiring, as shown in Figure 7-12, is fast and easy to install. The name comes from the conduit in which the power is distributed, which is easily bent or twisted. Components are inexpensive and widely available. They include plug-in receptacles for power and lighting circuits, distribution and junction boxes, adapter assemblies, and switching modules. Cable-sets should be coordinated with both lighting and equipment suppliers.

The use of flexible plug-in wiring is limited to power supply and lighting. Electronics and communications must be supplied through other means—an access floor, enclosed raceway system, or a plenum cable. The most serious disadvantage of flexible plug-in wiring is the ability to keep stringing the plug sets together. Frequent consequences are circuit overload, excessive voltage drop, and the tripping of a circuit breaker. The search for the problem area, because it may be concealed in a plenum, may be time-consuming and expensive. Further, while installation costs are relatively low, the costs of additional power-feeds or outlets is quite high.

Flexible plug-in wiring can be a reasonable alternative where equipment arrangement and needs are seen to be fairly stable.

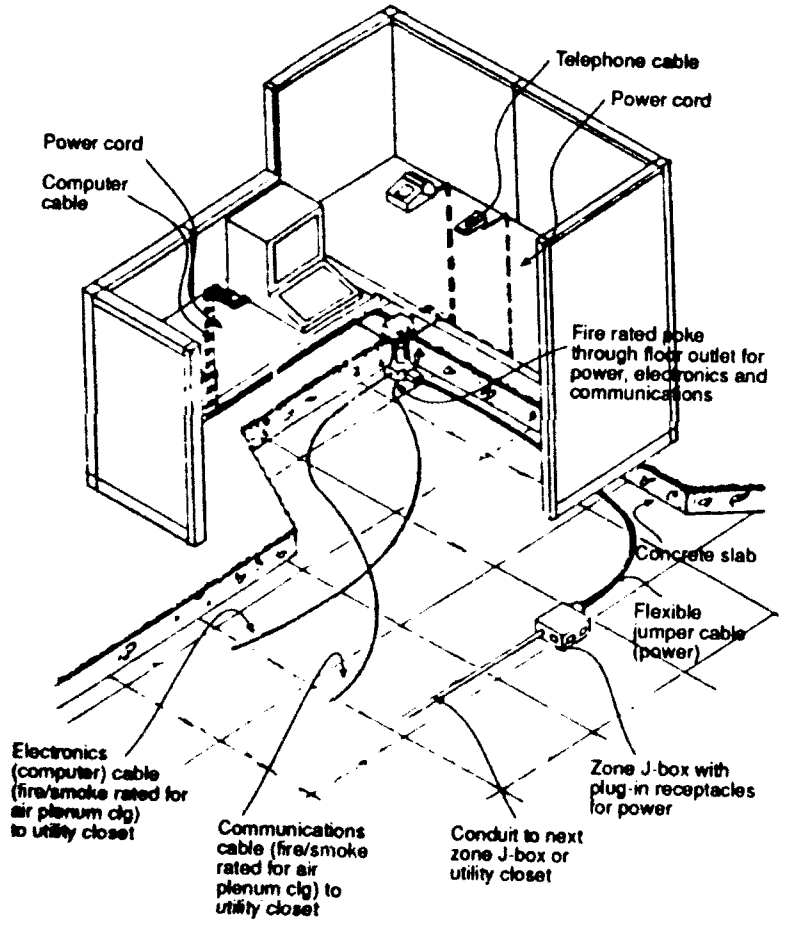


Figure 7-12. Flexible Plug-In Wiring

Cellular Floor

Cellular floor systems, illustrated in Figure 7-13, are designed primarily for use in steel frame construction. A cellular floor system consists of structural steel decking that is an integral part of the composite floor slab that distributes power, electronics, and communication service. A metal channel—a trench header—connects the individual cells and is installed flush with the finished floor slab.

Raceways are usually set 5 feet on center, with outlets placed on a specific preset module, typically 5 feet by 2-1/2 feet. The delivery of service is effectively limited to the locations of the preset boxes or distribution points. Outlets installed in the preset boxes may be either recessed or flush with the finished floor.

The flexibility of this system depends on the spacing of the preset boxes. It is best to locate these as close together as possible. When this is done, relocation cost is fairly low. New outlets in other locations may be installed, but the cost is significantly higher.

The cellular floor system accommodates power, electronics, and communication service. It does not, however, provide power service for overhead lighting. The use of a cellular system also requires the use of some type of sprayed-on fireproofing applied to the underside of the decking—to attain the proper fire-rating for the assembly. Finally, the use of the cellular floor system is not recommended in areas requiring EMP/HEMP and TEMPEST shielding because of the penetration of the floor system.

Underfloor Duct

Underfloor duct, as shown in Figure 7-14, consists of enclosed metal raceways in a concrete floor slab. Typically three raceways are used—for power, for electronics, and for communications. A trench header (with removable three-compartment cover) provides the raceway connections.

Outlet-inserts are factory-installed on 2-foot centers, and are set just below the surface of the slab. Raceways usually are 5 feet on center.

For installation of an outlet, preset inserts are tapped, and a pedestal outlet installed. Because the system has separate ducts for power, electronics, and communication, one outlet pedestal cannot provide all three services. Single pedestals must be installed for each service, which can lead to clutter and potential hazards.

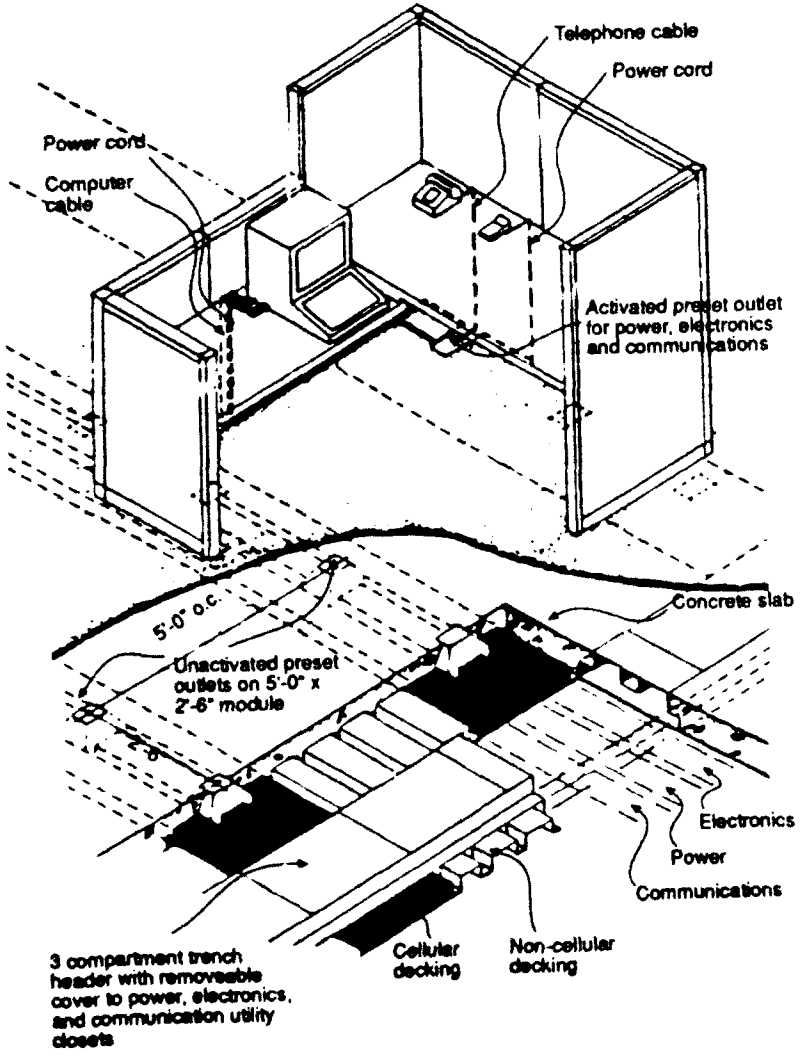


Figure 7-13. Cellular Floor System

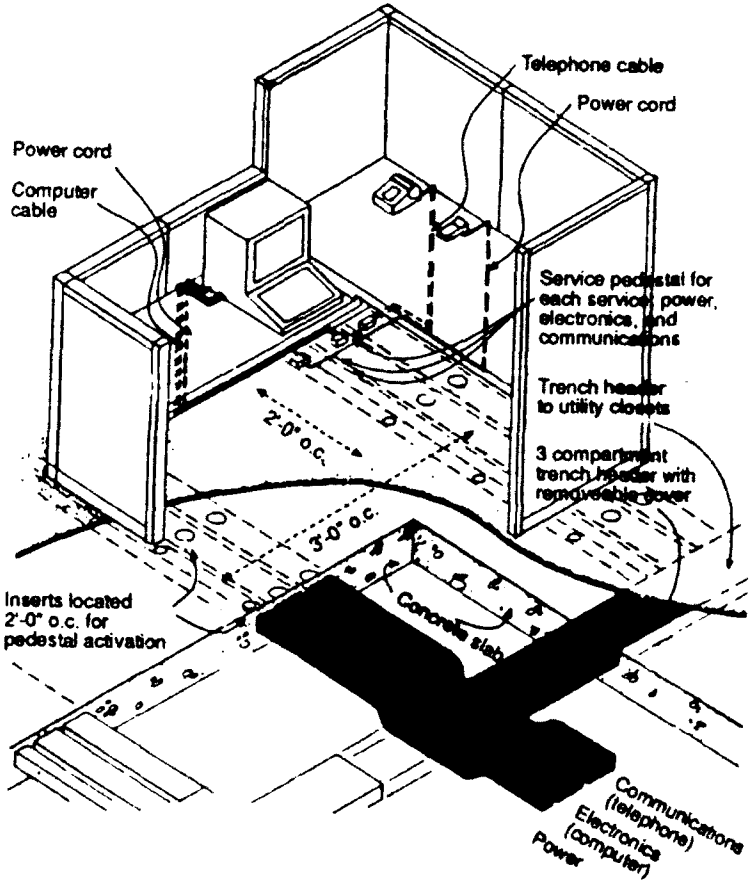


Figure 7-14. Underfloor Duct System

When pedestal outlets are abandoned, the work must be done by an electrician, who removes the pedestal and replaces it with an abandonment plate. These plates accumulate over the years with changes in furniture and equipment.

The underfloor duct system is among the most expensive to install, and it also is quite expensive to relocate outlets and service distribution points. This, along with the use of the awkward pedestal, makes the system among the least favored for a command center installation.

Flat Conductor-Cable

Flat conductor-cable, as shown in Figure 7-15, developed by NASA and marketed only since 1980, represents a major rethinking of the wire distribution in buildings.

Rather than clustering wires in cables, conduits, ducts, and cells, it spreads the wires into thin flat cables and runs them—protected by a plastic or metal bottom-shield and a steel top-shield-beneath the carpet tiles. Building standards limit the carpet tiles to 30 inches square, and require their easy removal with a pressure-sensitive adhesive. To prevent the abrasion of the cable, the floor slab must be free of dirt or rough patches. To prevent the disruption of data and voice signals by the electrical wires, manufacturers recommend the separate routing of these lines, and the crossing of them at 90-degree angles—both recommended to minimize contact. Where flat cables cross, or where they are spliced, taped, or folded to receive a branch cable or to change direction—the thickness of cabling can create lumps in the carpet tiles. To minimize carpet wear, the stacking of flat cables should not occur in circulation routes. Flat cable should not be laid until most construction work is complete, as heavy loads can damage the cable.

The advantages of flat conductor cable include the ability to run wires wherever needed and to relocate outlets quickly with a minimal disruption of, or visual intrusion upon, an office. Costs associated with other distribution systems—such as drilling through the floor slab, installing ducts, or adding a second raised floor—are eliminated.

Flat cable also has some disadvantages.

- It has limited length and capacity: cable over 50 feet in length can attenuate signals to the point where they may not serve the equipment.

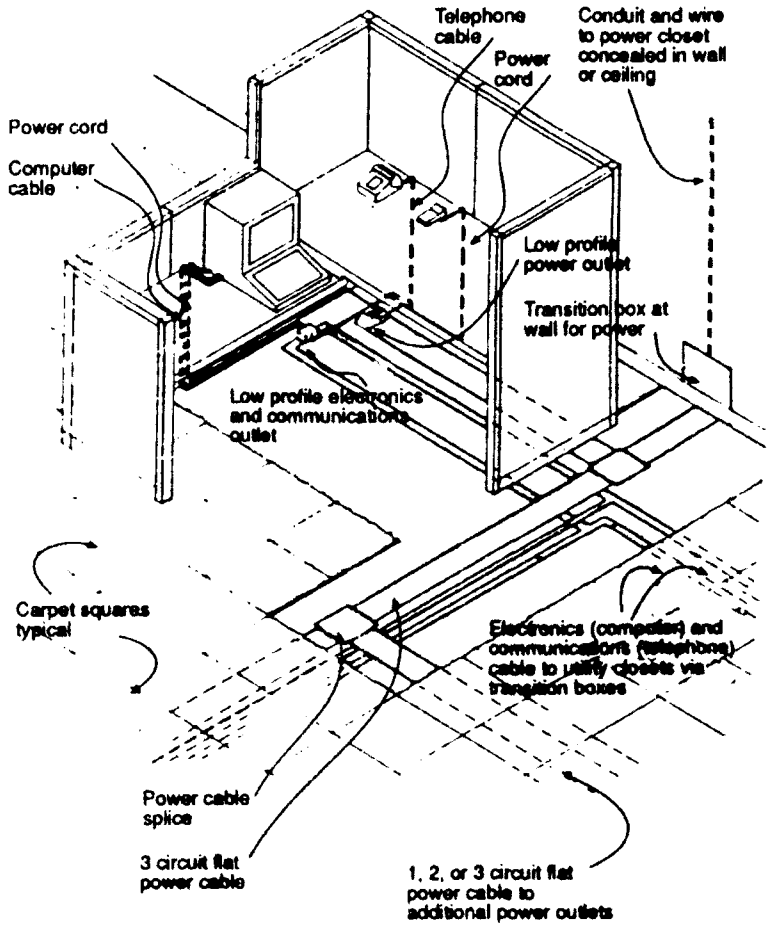


Figure 7-15. Flat Cable System

- While the under-carpet location of flat cable minimizes its visual impact on an office, it requires the use of carpet tiles, which some consider less desirable than broadloom carpet.
- Some flat cables, particularly thick coaxial data-cables, are not easily covered by carpet. Recently available carpet tiles, however, have tougher backing, denser weaves, and more patterns—all of which help to bridge-over or hide cable. A dark-colored, textured carpet, and loop- rather than cut-pile, also help disguise cable locations.
- Flat cables are best used as extensions of a primary distribution system. Serving a whole building in flat cable, which is more expensive than normal wiring, is not cost effective.

In spite of flat cable's limited length and capacity, it can meet most normal office data needs. When used with other horizontal distribution systems or when linked to multiple risers in columns and in the core, length limitations can be overcome.

Ceiling Access

A ceiling consists of three elements: the underside of the floor or roof construction, the plenum, and the ceiling membrane. The plenum is the space between the floor or roof construction and the ceiling membrane. The ceiling membrane may be either attached to the floor or roof construction, or suspended from it, separating the plenum space, if any, from the space below it. The selection of a ceiling assembly includes consideration of the type of assembly, the mechanical and electrical services to be incorporated, and the ceiling membrane.

Ceiling assemblies may be classified as no-membrane, attached-membrane, and suspended-membrane. No-membrane ceilings consist of the underside of the floor or roof construction as the only element of the assembly; there is no plenum. Attached-membrane ceilings have the ceiling membrane attached directly to the underside of the roof or floor construction; there can be either no plenum space, or a small plenum space when the membrane is attached to frame construction. Suspended-membrane ceilings suspend the membrane below the roof or floor construction; they provide plenum spaces of various depths, governed by the requirements of mechanical/electrical systems and desired room heights. Suspended-membrane ceilings can be an efficient and effective means to access cables and ducts if the vertical depth of the plenum space is sufficient for a modular plug-in duct system.

Modular Plug-In Duct

A modular plug-in duct, as shown in Figure 7-16, uses a power-pole (vertical metal channel typically about 2 inches square) to deliver the power, electronics and communication service from the ceiling to a console or workstation. The system provides good flexibility, for it can supply service anywhere a power-pole can be dropped from the ceiling. The number of power-poles increases, however, when the number of workstations or the amount of equipment placed in the room increases. Power-poles can form a virtual forest of metal, interfering with sight-lines. This is an especially important consideration in command centers, in that much of the decision-making process centers upon the display of information on walls, boards, or large screens.

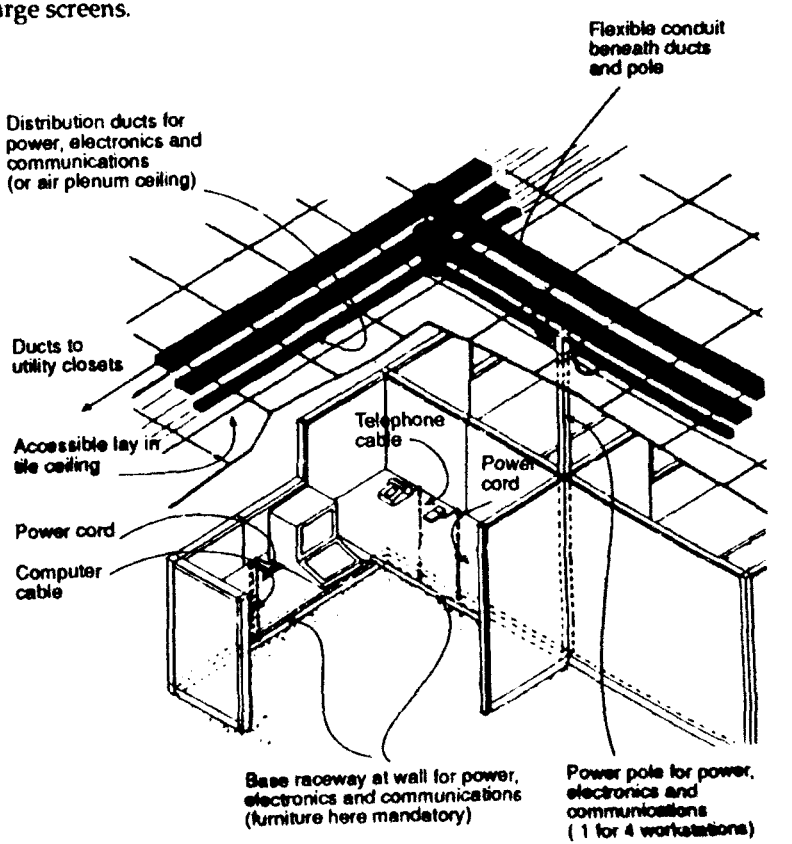


Figure 7-16. Modular Plug-In Duct

Comparative Analysis of Access Systems

Hammel, Green and Abrahamson, an architecture and engineering firm, conducted a comparative analysis of the access alternatives. The analysis assumed that none of the systems would be used alone, as a single system, to satisfy all requirements. Two major conclusions of the study were:

- All of the major systems, with the exception of underfloor duct, are close enough in price to allow other considerations to determine the choice—considerations such as availability, adaptability to existing structure, and ease of installation.
- All of the systems are significantly less expensive when used in conjunction with ceiling lighting, rather than with little ceiling lighting and emphasis on individual work-station task lighting.

The chart in Figure 7-17 shows some comparative cost-rankings—for comparison only. Actual costs always depend on local conditions, configuration of the building, and specific power, electronic, and communication requirements.

Command centers place unique requirements on a utility-access system. Great flexibility in utility development is necessary to the proper completion of the mission.

The various advantages and limitations of the accessibility systems are summarized in the table in Figure 7-18.

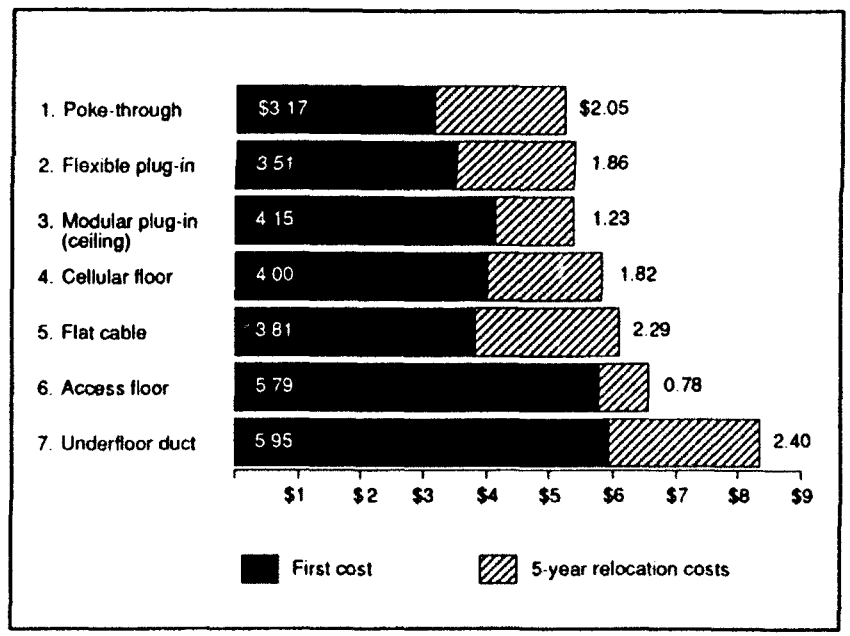


Figure 7-17. Life Cycle Cost Comparison (cost per sq. ft. of total space)

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	Poke-through systems	Modular plug-in/ power pole systems (from ceiling)	In-floor ducted systems	Cellular deck systems	Flat conductor cable	Access floor systems	Flexible plug-in wiring
ADVANTAGES	Minimal visual intrusion	Pole easily relocated	Minimal visual intrusion	Minimal visual impact	No limit in spacing or routing of cables	Almost unlimited cable capacity and routing widely available	Components inexpensive and
	Installation can be delayed until space function is determined	Installation can be delayed until space function is determined	Can be used with flat cable for added flexibility	Integration of cells in structural deck reduces cost and field labor	Outlets quickly installed and easily relocated	Outlets easily relocated	Outlets can be relocated without an electrician
	Cables are easily accessible in ceiling plenum	Cables easily accessible in ceiling plenum	Cables protected from damage or security breach	Preset outlets easily relocated	Installation can be delayed until space function is determined	Potential for housing HVAC system underfloor with potential reduction in floor to floor height	Minimal visual intrusion
		Data cables secure in office's own ceiling	Organization of wires simplified	Organization of wires simplified	Minimal visual impact		
		No limits on spacing or total number of outlets	Preset outlets easily relocated	Depending on the number of activated cells, cable capacity can be large and outlet locations flexible			
LIMITATIONS	Outlet relocation disrupts floor below	Poles visually intrusive	Extensive sheet metal work required at installation	Added fire protection required under activated cells	Carpet tiles must be used with flat cables	High initial cost	Circuits are easily overloaded as cable sets are added
	Possible security problems with data cables in another office's ceiling	Many poles create an unprofessional atmosphere	Potentially less capacity in distribution ducts than in cellular deck	Without flat cable, connections among equipment in an office can involve lengthy cable runs	Floor slab must be free of any abrasive material or surfaces	Some systems less resistant to heavy rolling loads	Cannot accommodate electronics and communications lines
	Limits on outlet spacing (2 feet on center) and total number of outlets		Nonstructural ducts require second concrete slab when used in concrete buildings		Overlapping cables can create a lump in the carpet	Some panels create a hollow sound when walked over	Central power outlets cannot be easily relocated
	Care required during installation to ensure fire integrity of floor		Spacing of ducts often wider than that of activated cells in cellular deck	Best used as an extensionto a primary distribution system	Flexibility of system requires careful management plan for wiring		
		Without flat cable, connections among equipment in an office can involve lengthy cable runs		Cable more expensive than a conventional wiring system			
				Data cables limited to about 50' length			

Figure 7-18. Comparison of Cable and Duct Accessibility Systems

BUILDING SECURITY

Security Systems

The design of command, control, communications, and intelligence (C3I) systems of ever-increasing complexity has required that a systems engineering approach be used in all program phases, from requirements definition through conceptual design and development to deployment. Security systems engineering has recently evolved as an integral part of this overall systems engineering process. Security requirements are inputs to the overall system engineering design process. They should appear in functional descriptions and should be defined and documented just as operational requirements are. Some security design criteria will drive the design of non-security-related devices, particularly in the TEMPEST area. The relationship of security systems engineering to other engineering functions and other system elements is shown in Figure 7-19.

In the past, security has not been frequently addressed at a systems level. Communications security (COMSEC) has been applied mainly to developmenta' systems. Physical security has been applied to weapons systems at the system level and to individual areas (command centers, communications nodes), as the need is identified. Operational security (OPSEC) and information security have not been addressed until deployment. This has led to the design and implementation of systems that have failed to meet all the security needs of the required mission.

Figure 7-19 identifies four SECURITY PROGRAM ELEMENTS (within the dashed lines) for a comprehensive security system plan. This section of Part 7 contains information about selected facility components of three of the four programs:

- Vaults and secure work/storage rooms of the "Physical Security Program"
- Access control techniques for the "Access Control Program"
- Facility TEMPEST countermeasures for the "Information Security Program."

Vault Systems

Material deposited in a vault may not be secure from theft, since vaults can be penetrated in several ways if the adversary has access, time, and proper equipment. Vaults considered in this section are large, walk-in types with either single-leaf or double-leaf doors and concrete, steel, or concrete-steel walls, floors, and ceilings. Usually they are inside a larger structure and not free standing.

A vault consists of four basic structural elements—floor, walls, roof, and door(s)—which should meet specific criteria for material containment. In addition, some vaults require ventilation ducts that must be considered potential entry paths for adversaries, as illustrated in Figure 7-20.

The location of a vault inside a building can be a factor in determining its penetration resistance: for example, placement on an exterior wall versus placement completely inside the building. An exterior wall location may give an adversary a stealthy penetration path, or it could permit the use of explosives on the wall or roof with the same ease with which an exterior building wall could be attacked. When the vault is placed inside the building, the adversary may be reluctant to use explosives or may be limited in the amount he or she could detonate without causing a structural failure from overpressure, shrapnel, or both.

The openings for vault door(s), ventilation ducts, and other parts may be a weak point in an otherwise hardened structure. However, since openings are necessary for access and utilities, they should be considered in the vault's overall penetration resistance.

Vault Doors

By definition, class A and B vaults require a class 5 vault door, whereas a class C vault requires a class 6 vault door. Class 5 and 6 vault doors are available on the Federal Supply Schedule. The door requirements are specified in Federal Specification AA-D-600, copies of which can be obtained from any regional office of the General Services Administration (GSA). In general, a class 6 vault door is primarily a fire door and is not intended to provide forced entry protection; it is only recommended for "confidential" level classified material. In addition to vaults, class 5 doors are authorized for AS&E storage facilities. As with personnel doors, class 5 doors have penetration times less than 1 minute against optimal attack tools.

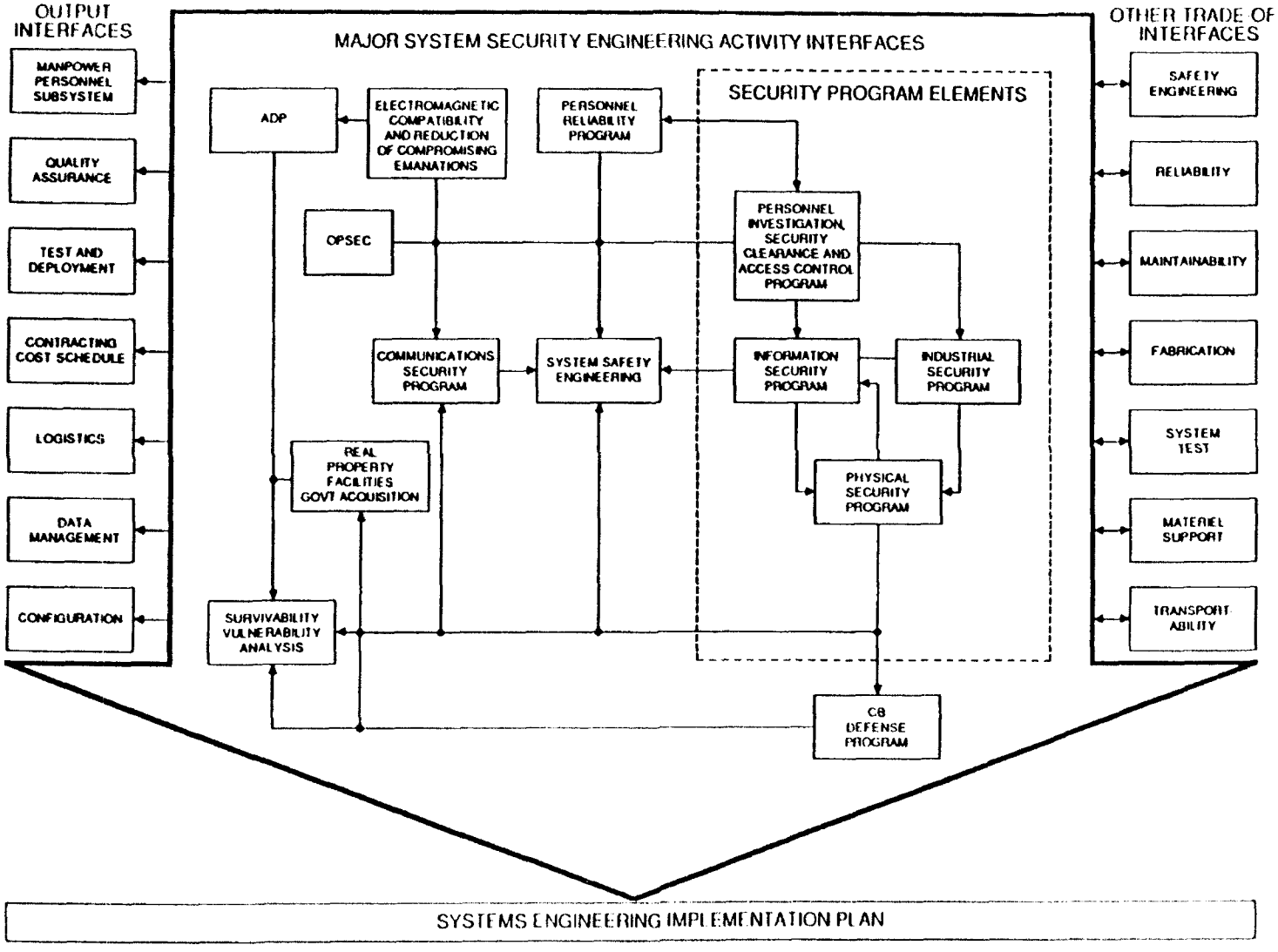


Figure 7-19. Security Systems Engineering

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Class 5 vault doors, which conform to Federal Specification "Door, Vault, Security AA-D-600B," theoretically afford the following security protection:

- 30 man-minutes against surreptitious entry
- 10 man-minutes against forced entry
- 20 man-minutes against lock manipulation
- 20 man-minutes against radiological techniques.

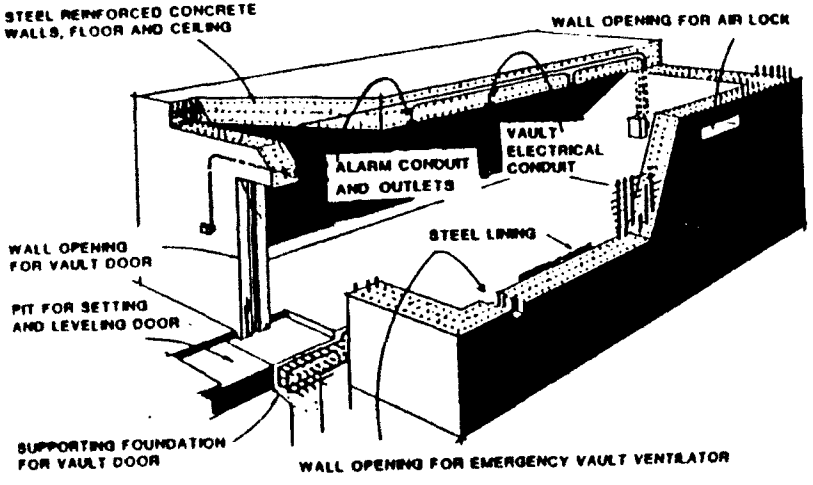


Figure 7-20. Vault Construction

Vault Locking Mechanisms

In general, the locking mechanisms used on doors for security are combination locks coupled to engage bolts; they are tested to withstand 20 man-hours of lock manipulation. However, the typical class 5 locking mechanism is vulnerable to penetration by hand tools, thermal tools, hand-held power tools, and explosives. Tests have shown that penetration is possible in 2 to 5 minutes. Other locking mechanisms are available with additional features such as automatic deadbolts that are activated by drilling or by thermal or explosive penetration attempts, time locks, wedge locking bars, and locking thresholds. These locking mechanisms will require evaluation before improvements in delay resistance can be established.

Class A Vault for Classified Material

For constructing the class A vault, floors and walls must be 8-inch-thick reinforced concrete. Walls will extend to the underside of the roof slab above. The roof must be monolithic reinforced concrete slab of thickness to be determined by structural requirements, but not less than wall and floor thickness. When the underside of roof slab or roof construction exceeds 12 feet high or when roof construction is not in accordance with that just described, a normal reinforced concrete slab ceiling will be placed over the vault area at a height not to exceed 9 feet.

Class B Vault for Classified Material

The minimum desirable protective design for essential communications facilities (including back-up power) must be a class B vault. Although this requirement primarily applies to new facilities, existing structures should be modified to approach Class B vault construction standards when economically feasible. No windows are permitted.

The Class B vault is a repository that can be used to store classified material under the conditions stipulated in AFR 205-1. This classification of Class B vaults can be upgraded by added supplemental security features or by an inherently secure environment.

For construction of the Class B vault, floors must be monolithic concrete of the same thickness as adjacent concrete floor construction; however, the vault floor slab will be not less than 4 inches thick.

Walls must be no less than 8 inches thick and should be made of brick, concrete block, or other masonry units. Hollow masonry units must be vertical celltype (load bearing) and must have cells filled with concrete and steel reinforcement bars. In seismic zones 2, 3, and 4, use steel reinforced monolithic concrete walls no less than 4 inches thick.

The roof must be monolithic reinforced concrete slab of a thickness to be determined by structural requirements. When the underside of roof slab or roof construction exceeds 12 feet high or when roof construction is not in accordance with that just described, a normal reinforced concrete slab ceiling will be placed over the vault at a height not to exceed 9 feet.

Improved Penetration Resistance

Existing vaults usually consist of a hinged steel vault door mounted in a reinforced concrete structure. Penetration time with hand, power, and thermal tools is usually less for the vault's door than for its walls, floor, and ceiling. Because of the greater penetration time it affords, a reinforced concrete door the same thickness as the surrounding structure could replace a steel vault door to balance the vault's overall penetration resistance.

In general, data indicate that conventionally constructed doors, windows, and utility openings offer very little attack resistance (typically less than 2 minutes). Attack-hardened single barrier door options for which data are available offer penetration times up to nearly 30 minutes. These door surfaces are constructed of a multilayered wood/steel combination. The facilities engineer should note, however, that these penetration times apply only to door surfaces; they do not apply to locking devices that are integral to the secure door system. No state-of-the-art locking devices provide penetration resistance in excess of 7 minutes. A user seeking to design a 30-minute door, for example, might consider using multiple locking devices.

Some existing vaults and vault doors may not provide the penetration time considered necessary for certain security systems. The balanced design concept should be followed: designing each component to provide about the same penetration time. It may not be effective to improve the vault structure and not the vault door(s). Conversely, to replace a 3-minute door with a bank-vault door at great expense may improve the door itself, but would not increase the resistance of the overall structure.

One improvement that can provide more thermal penetration resistance to some doors is the installation of redwood liners, an addition that has increased cutting time by a factor of four. A vestibule with a second vault door, in which only one door at a time would be open, could be used. The vestibule concept could be coupled with one of the dispensable deterrents for increased penetration resistance.

A vault wall's penetration time can be increased by installing a steel liner to form a sandwich wall. This type of wall has been tested by explosives, with the amount of explosives required for penetration increasing by a factor of five. When the vault has exterior wall and roof surfaces, some type of overburden could be enhanced by soil cement, crushed automobile bodies, or other such barriers to increase the penetration time.

Wall concepts that increase resistance to cutting and thermal tools include: (1) composite and ceramic materials; (2) different aggregated materials used for concrete, such as lead shot; and (3) ceramic balls. Concepts are also being evaluated for energy absorption, to increase flexibility and thus reduce damage from explosives. Stand-off or cavity walls are being studied to determine their ability to absorb blast energy and to improve penetration resistance to thermal attacks. All of these concepts could be applied to vaults.

Underground Vaults

With underground vaults, several feet of reinforced concrete would surround the storage compartment, which would be encased in a floor. Access would be controlled by a coded locking mechanism with an electrical system to lock or close the vault when the facility is under attack. The aboveground vault has many of the side features as the underground vault except that a deep overburden has been used to resist penetration from above.

Secure Work/Storage Room Systems

A crypto work room provides the workspace required for encoding and decoding. Normally, a safe or vault is provided in the room to house and secure crypto matter when not in use. For construction, exterior walls must be the same as for the basic structure. Enclosing partitions will be of normal construction, with a minimum 1-hour fire resistance rating. Combustible material will not be used as wall and ceiling finishes. Soundproofing will be to a degree that will not allow the type of operations to be recognized by interpreting mechanical sounds. This soundproofing will be evaluated apart from the soundproofing requirement for personnel and equipment in the

crypto room. Omission of windows in the crypto room is desirable, but not mandatory. When installed, they must be barred and screened in so as to prevent viewing of the room from any outside point.

When a room has a vestibule, the inner door can be standard grade commercial wood or metal. The outer door to the room can be either commercial solid wood or metal with the same fire resistance rating as the enclosing partitions of the room. The door frame will be metal of minimum 16 gage. Heavy-duty hardware with an integral locking device operable from the inside is good enough for normal operation. For special operating conditions, an approved lock, such as a three-tumbler, 100-number face dial with a changeable combination, can be used by the local commander. When a combination lock is used, the crypto work room will have a phone and an alarm device. The alarm will transmit to a central manner location by any person who might be accidentally locked in the room. Instead of the above combination lock and alarm, install a manipulation-proof, three-position, dial-type combination lock with an interior safety release turn knob.

A secure storage room holds classified matter and records. It can be any designated room that has increased security protection through supplemental measures such as intrusion detection alarm systems, guards, guard patrols, or personnel on duty. Rooms selected or constructed for this purpose shall consist of an interior space enclosed by or separated from other similar spaces by four walls, a ceiling, and a floor, all constructed of solid building materials. Removable panels and the like shall not be used. Windows and other openings shall be enhanced by covering with number 9 gage, 2-square-inch steel mesh or 1/2-inch steel bars installed no more than 6 inches apart. The room must be constructed so as to provide a physical barrier that cannot be breached without leaving evidence of actual or attempted entry into the secure room. If an alarm system is used, it must, at a minimum, provide immediate notice to a security force whenever surreptitious or forced entry is attempted. Vault doors or other substantial doors can be used as compatible with the environmental, supplemental support, and operating requirements.

Doors (vault-type) are to be selected from the doors specified for Class A and B vaults above. Substantial doors for secure storage rooms have two-ply wood cores covered with 26-gage galvanized steel, with each wood ply no less than 25/32 inch thick. The two-ply doors must be constructed with one wood layer vertical and the other horizontal. An alternative is to use a 1-3/4 inch thick door with a solid wood core covered with 26-gage galvanized steel. Frames for substantial doors of secure storage rooms must be of 16-gage hollow metal or of structural steel channels as compatible with the strength of the wall construction. Provide tamper-proof, heavy-duty, fixed-pin door hinges or butts. Install a manipulation-proof, three-position, dial-type combination lock with an interior safety release turn knob.

Access Control Techniques

The security system must provide the command centers with the capability to withstand intrusion by individuals or groups intending to compromise the operational activities or the security of information relative to the command center's functions.

Security measures are implemented using a concept of "security zones" to produce defense-in-depth for the protection of a command center facility and to facilitate the assessment of security effectiveness by providing well-defined zones for the use and evaluation of physical protection. Security measures when applied to each security zone will result in a multiple number of distinct countermeasures that an intruder must defeat in sequence to reach an intended target.

Security measures applied to each security zone should have one or all of the following effects:

- Provide intrusion deterrence by producing an obstacle, real or imaginary, to a potential intruder.
- Increase intrusion delay by increasing the time required for the intruder to penetrate barriers to reach the intended target and by burdening the intruder with special or added equipment needed to penetrate the barrier.
- Facilitate intrusion detection by effective placement of sensors.
- Facilitate alarm assessment by providing well-defined regions for visual or audio interrogation of sensed intrusions.
- Enhance effectiveness of security forces by increasing the probability of intrusion detection and by providing enough intrusion delay to allow an effective and timely response to intrusion.

The physical security system includes barriers to protect the facility from attack and sensors to detect intrusion. The sensors are monitored electronically to alert a response force to an alarm condition. These monitoring systems can be as simple as lights showing status or as complex as a dedicated computer system showing facility layout with a pointer to where the alarm is

occurring. Access control systems can also be integrated into such computer-based systems.

Barriers

Barriers delay the attack and act as a time deterrent to allow a response force adequate time to react to an alarm. The barriers may be constructed to make the attacker go through a series of gates before reaching the protected area. The amount of time delay each gate provides is that amount that has been identified in the conceptual design as necessary to protect the area. Barriers can include physical, technical, and procedural barriers and combinations thereof.

Physical barriers are constructed such that an adversary must use physical force to penetrate the barrier. Facilities may be constructed of bulky, armored, or abrasive material, heat sinks, sealants, etc. to delay entry at the possible points of penetration. This may include penalties such as acoustic, chemical, or explosive devices that will delay, stop, or even kill attackers. (Use of lethal devices requires DoD-level approval.) Mechanisms to shut down critical equipment, erase secure codes, disable weapons, or destroy sensitive equipment or information sources may be used. These mechanisms are used with tamper sensors to ensure the mechanisms operate at the right time.

Technical barriers include intrinsic and deliberate barriers. An intrinsic barrier exists when the system's design is inherently complex. The complexity prevents a person from attacking the system if he does not have the technical expertise to operate the system. An example is a communications system containing a multiplexed link. A person not familiar with electronic communications may not be able to attack the system covertly at this point.

A deliberate barrier exists when the system is made arbitrarily more complex and more difficult to attack. The addition of encryption to the communications system used as an example above is an example of a deliberate barrier. A more familiar deliberate barrier for physical security is the use of an entry control system with time limits on personnel access, high security combination locks, electronically controlled locks, and mantrapped entries.

The three types of barriers can also be used in combination to provide added security. For example, an entry control system can be a physical barrier by using a locked, physically protected door. The use of a high security lock represents the technical barrier. (A person must know how to open the lock.) The process of identifying authorized personnel and allowing them access is the procedural barrier.

Sensors and Alarm Reporting Systems

Sensors are used in conjunction with barriers to detect intrusion or unauthorized access. They detect changes in the environment that are caused by an attack. Sensors may be either passive or active. Passive sensors can detect factors such as air pressure deviation, temperature drop or increase, changes in light intensity, sound pressure levels, and seismic activity. Also, passive sensors can detect changes in an electric or magnetic field around an object or a perimeter. Active sensors emit energy and detect changes in the return signals from this energy. Typical active sensors transmit low-level microwave energy, ultrasonic sound, or light (either visible or infrared), and detect variations in the reflected signals returned from objects in the sensor scan area. Figure 7-21 shows a representative facility and the types of barriers and sensors that might be used.

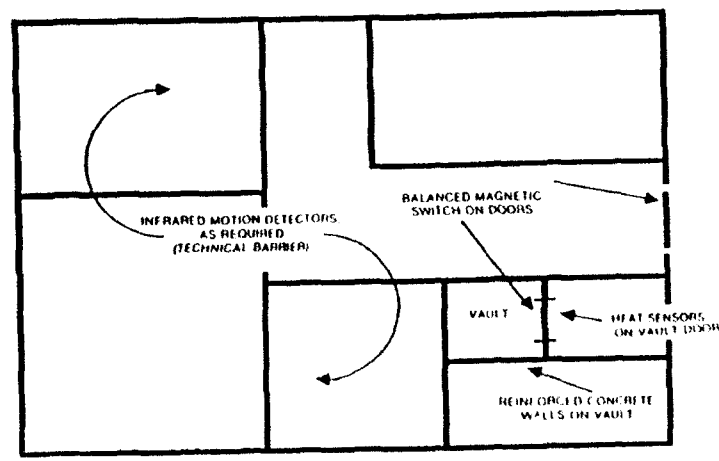


Figure 7-21. Facility Barriers and Sensors

Alarm reporting systems include a wide variety of equipment used for communicating alarm information from intrusion detection sensors to security personnel. In general, alarm reporting systems must be considered from both a hardware/engineering viewpoint (alarm transmission techniques and line security considerations) and a system-procedure/human-factor standpoint (display and console equipment abilities, features, and layouts).

Alarm Communication Systems

An essential part of an intrusion detection system (IDS) is the alarm communication system, which transmits information from the sensors to the alarm display equipment. Two principal considerations of alarm communication systems are (a) the basic economic and technical aspects of the technique used to transmit the alarm information; and (b) the degree of security provided for the communication link. Several fundamentally different approaches can be taken to both alarm transmission and communication security. The advantages and limitations of each should be well understood so that the best technique for a given installation can be selected.

A wide variety of systems is available for presenting security information to security personnel, including:

- Annunciator panels that provide individual lights to display the status of every alarm circuit simultaneously
- Numeric readouts that use a single digital display to report alarm information from one alarm circuit at a time
- Computer-driven cathode ray tube (CRT) displays that can present a variety of information about several alarm circuits simultaneously.

These approaches to alarm display offer a wide range of capabilities but also present distinct limitations and disadvantages. However, in selecting a particular alarm display stem for a specific installation, it is essential that the features and capabilities required for the intended application be well understood. In particular, there is no one "best" system for transmission and display of security information. Rather, a system should be selected to meet the need of the specific installation. It should also be noted that many systems may provide more capability than is needed or desired and that paying for unused features would tend to increase the system's cost.

Techniques available for transmitting alarm signals include land lines, radio links, dedicated point-to-point circuits, and shared multiplexed circuits. Each technique offers unique cost and performance advantages and each is usually best suited to a specific set of conditions.

In addition to the economical and technical aspects of the alarm transmission method, security must be considered for preventing or detecting improper reporting of alarm information due to accidental damage or malevolent attacks to the communications system. Two general approaches to secure communications are physical protection and supervisory techniques.

- Physical protection includes practices such as installing the communication line within the secure area, enclosing the line in conduit, burying the line (often in concrete), installing tamper sensors, and routinely patrolling the cable route.
- Supervisory techniques are characterized by some type of signal being continually transmitted along the communication link; this signal is constantly monitored to determine if the system is operating correctly and if the data have been altered during transmission. Regardless of the line supervision system used, such a system can almost certainly be defeated if the adversary is allowed access to the line for enough time and if the adversary has adequate resources and technical expertise; therefore, the line must be additionally protected by physical techniques to allow detection of attempts to gain access to the line.

The alarm reporting system should be compatible with security procedures and regulations. Although regulations are externally mandated to ensure that maximum security requirements are met, procedures are usually established by the installation. The role of procedures should be to state formally the rules to be followed and responsibilities of security personnel required to realize an efficient and effective security system. Among the reasons for adopting or continuing procedures are:

- To satisfy a regulation
- To address a specific problem which is site-dependent
- To accommodate the alarm reporting equipment (e.g., a Premises Control Unit that requires a guard to reset an alarm)
- "It has always been done this way."

The first two reasons are valid, but the last two are questionable. Procedures should be reviewed periodically to evaluate their relevance. Acquisition of an alarm reporting system provides a good opportunity for this review. It is essential to determine how the proposed equipment will affect the existing

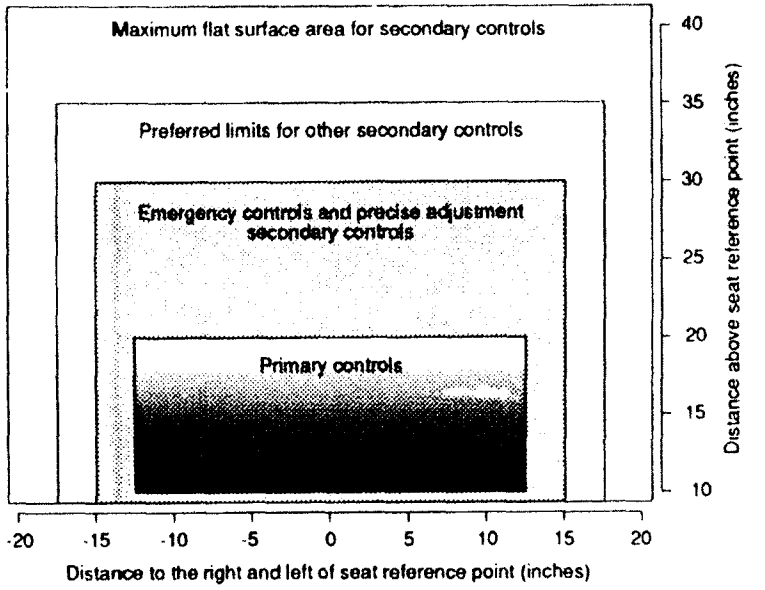
procedures: that is, which procedures can be eliminated and what new ones will have to be instituted. Only then will it be possible to assess realistically the overall impact of a new or different alarm reporting system on security and guard operations.

An example of this point is the Premises Control Unit (PCU). If a PCU is included in an alarm reporting system, it is necessary to have someone at the remote site to set the zone to access or secure mode and to reset alarms. This may increase security by ensuring that someone visits an alarm site; however, it also requires additional manpower. It is possible to obtain systems that do not use a PCU and suffer no degradation of security. A guard could still visit the alarm location and report back without having to reset the alarm in the field. The inclusion of a PCU in a system should be based on a thorough analysis of the security needs, manpower, and other considerations; it should not be used simply because it is part of a vendor's "standard" system.

Another example of the important interplay between equipment and procedures is illustrated by tamper detection/line fault capabilities. If indications of these problems are ignored routinely, the additional equipment required to provide these capabilities is essentially wasted. On the other hand, if "trouble reports" are prepared for maintenance personnel as a result of these indications, true hardware problems will eventually be corrected and some instances of malevolent tampering may be discovered after the fact. However, the full benefit of these capabilities will only be realized by a response procedure requiring that the systems be inspected whenever the indication is received, thus increasing the likelihood of apprehending an intruder.

No matter how sophisticated the system is internally, its external features should be engineered for the human operator. The guard/operator generally will have tasks to perform in addition to monitoring the display panel. The work area should be designed to coordinate these functions. The space available around the operator would contain areas of varying accessibility and visibility. Figure 7-22 indicates how the space can be divided into different control areas. The main operating controls should be located in the primary area, with lesser used controls located in secondary areas.

Communications equipment such as microphones and telephones also should be integrated into the system. They should be within reach, operable with at most one hand, and have long enough cords to allow the operator any necessary mobility. CCTV monitors and control, if present, must be incorporated into the console design with the display and control space suitable for their intended function. The location of any auxiliary equipment should be in relationship to its importance and frequency of use.



Preferred vertical surface control areas

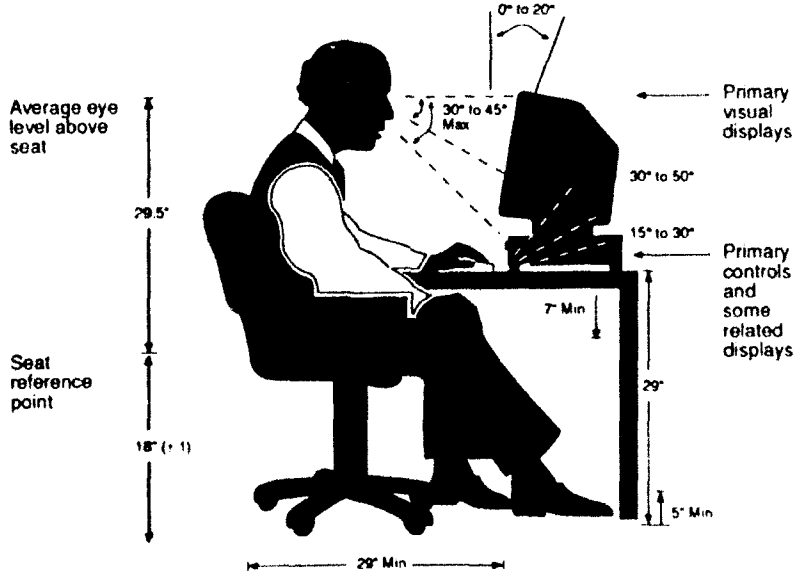


Figure 7-22. Alarm Console with Primary Visual and Control Areas

Because the operator's attention may not always be directed to the display panel, there must be a way to attract his or her attention whenever it is required. Auditory stimuli could be used to alert the operator to a change of status and to indicate the general nature of the problem (e.g., fire, intrusion, explosion). Variable frequency sounds, such as sirens, are more alerting than steady-state sounds. Once the operator's attention is directed toward the display, a visual signal (e.g., a flashing light) can accentuate the important information. Colored lights or indicators can be used to indicate more clearly the alarms' status.

The operator's work environment can vary between the extremes of boredom and exhaustion, depending on the workload. The workload should be composed of prioritized tasks, ensuring that the most urgent tasks are performed as soon as possible. Unrealistically heavy workloads that could lead to stress and fatigue should also be avoided. If more than one operator is to be active at one time, it may be desirable to have a duplication of the essential display and communications equipment.

Although security can be maintained with a system that simply reports whether a zone is alarming, many display systems can present other types of information as well. Examples include:

- Access/secure alarm status of the zone
- Geographic location of the zone
- Time of alarm
- Supplementary text providing additional information such as special hazards or material associated with a zone
- Instructions describing special actions to be taken
- Telephone numbers of persons to call in emergencies
- Graphs or maps of the secure area.

Much of this information cannot be presented on annunciator or numeric displays. If a CRT display is used, the information displayed is subject to the CRT's limitations, such as the number of characters that can be written on each line and the number of lines that can be written on the screen.

Access Control Equipment

Access control can be accomplished by manual, machine-aided manual, or automatic means. Manual systems use guards to control access by comparing the photograph or the personal characteristics described on an identification card with the person requesting access. Based on the visual identification, the guard can either allow or deny access. Machine-aided manual systems automate the process of accessing the identifying characteristics such as photographs or personal data, but a guard still makes the final identification and grants or denies access. Automatic systems use authentication devices including keyboards and memorized codes, cards and card readers, video comparators, and biometric identification devices to determine the validity of an access request.

Choosing an automatic access control system requires that three factors be evaluated. The most important factor is the system's resistance to spoofing through the counterfeiting of the necessary identification characteristics in order to gain entry. Biometric identification devices, which employ biological characteristics as authenticators, have the highest resistance to counterfeiting. The reliability of comparison of video images by an operator is dependent upon that operator, and usually considered to be high to medium. Devices that rely on a card or on a memorized number are considered to have the lowest resistance to spoofing.

Another factor is a system's ability to prevent "tailgating." This is the act of two or more persons gaining entry on one person's identification. This may occur due to a door not closing properly or taking too long to close. Methods to prevent this range from an alarm if the door remains open too long (low security), to a turnstile (medium security), to a vestibule access door where an individual goes in one door, identifies himself, and then is allowed entry to the facility through a second door. Sensors are used to ensure that only one person is in the vestibule at a time. This type of system is used where high security is required. For very high security environments, this system can be used as a mantrap, where an access request denial results in the locking of both doors so that the requester cannot exit without response force intervention.

The final factor is throughput rate. The throughput rate is the inverse of the average verification time for a single individual to gain access to a controlled area. A requirement typical of command centers is the need for a large inflow of personnel in a short period of time during a crisis or other nonscheduled activity. For instance, a verification time of 6 seconds (throughput rate of 10 per minute) for a population of 30 people requires 3 minutes for

access of all personnel. If faster throughput is necessary, dual systems can be used, or guards can be used as secondary access control during the peak traffic.

Keyboards and Codes

Access control systems using numerically controlled locks have a keypad or keyboard, and access depends upon a code being entered correctly. These systems provide the lowest level of access control security. The best use of this type of authentication device is as an adjunct to other devices that provide a higher level of reliability.

Encoded Cards and Card Readers

Most of the available access control systems use encoded cards and card readers. The readers identify individual cards (not the individual), which are susceptible to loss or theft. Typical control systems allow for quick invalidation of lost cards and can also restrict entry to certain times of day. Various technologies are available for the encoding of the cards. The types of cards/readers and their security aspects are discussed below:

- Barium ferrite. Magnetic spots of barium ferrite are laminated between two layers of plastic to form a distinctive code. These dots are subject to erasure, and the cards wear out faster than those using other technology.
- Magnetic stripe. These are the familiar stripes on the backs of most commercial credit cards. The stripes are subject to erasure and to damage. A relatively large amount of data (approximately 4 kbytes) can be recorded on a magnetic stripe. New developments in magnetic materials have resulted in a card with a much lower chance of counterfeiting. A permanent, nonerasable number can be magnetically recorded on the card. Other data can be recorded over this permanent number, but it will always be available for verification. The magnetic stripes used in such cards are called high coercivity stripes.
- Bar code. This is similar to the National Product Code (NPC) bar coding on commercial packaging. Codes are read in the same manner as in a grocery store using a laser scanner inside the reader.
- Infrared. This is a very secure type of coding that relies upon a bar code implanted inside a card. Low-level infrared light is passed through the card to read the code. Counterfeiting is very difficult and the costs of the system are commensurately higher.
- Weigand effect. This is another magnetic effect reader that uses pieces of wire reacting in a magnetic field for encoding of data. The wires are imbedded in a card in a unique pattern. Both the card and reader are sealed units and thus are not subject to weather, wear, or vandalism.
- Reflected frequency or proximity. These readers use radio frequencies to read a code contained in a card. Readers will operate up to a distance of about 28 inches from the card, so users need not display their cards to gain access, but simply have to position them within that distance. This allows for a very high throughput rate. Security is high and counterfeiting is difficult.

Video Comparators

The video comparator is actually a machine-aided manual system. A personal identification (ID) and/or personal code (usually called a PIN - Personal Identification Number) is used to retrieve a stored image of the person desiring entrance. A guard at a central monitoring post can compare a real-time video image to the stored image and grant or deny access. Throughput rate can be a problem, especially if the guard must respond to access requests from several entries. An experienced operator can handle up to 150 personnel in 15 minutes for a verification time of 6 seconds. Security can be very high but is dependent upon the operator's experience and dedication.

Biometric Authentication Devices

Biometric is the generic term used for the technologies associated with the use of biological characteristics as authenticators. This term is also used when discussing learned traits such as signature dynamics or voice patterns. Biometric authentication devices are different from all other authentication devices in that the biometric devices rely upon some personal characteristic that is inherently and uniquely associated with an individual to identify that individual. Presumably, that characteristic cannot be duplicated and thus the use of such a system results in a positive identification of an individual. While not entirely true, biometric devices do have a substantially increased antispoofing capability versus the more common types of authentication devices. The problem stems from the fact that as a particular characteristic is developed into a repeatable authenticator, the opportunity for duplication of the authenticator becomes greater. Thus, the ideal characteristic upon which to base an authenticating system should be something that is repeatable but nonduplicatable.

The need for repeatability has resulted in the use of statistical means to authenticate a particular individual. Thus when a person is to be allowed access to a facility, he must be enrolled in the system by having a number of "measurements" taken to the identifying characteristic and the results entered into the system. Upon a request for access, the "new" identifier is compared statistically, i.e., some percentage of the new identifier must agree with the old, against the composite measurements and access is either granted or denied. This statistical approach leads to two types of errors. The industry has defined these as Type I error - the rejection of a person whose identity claim is valid; and Type II error - the acceptance of an impostor. Typically, the more measurements taken during the enrollment process, the higher the accuracy of the system. Usually the amount of correlation between the new identifier and the stored data necessary for access grant can be set by the user.

Biometric authentication devices can be used in two different modes. The first is as a part of a verification system where an individual requesting access enters a PIN or uses some other means of identifying himself and then the biometric device verifies that identity. This is usually the faster of the two, resulting in a higher throughput rate. The other mode is identification of an individual out of the entire database of the system. The time for the search for and comparison of the characteristic can be quite long.

Current biometric systems use five different physical characteristics for authentication: hand geometry, fingerprint pattern, retinal scan, signature dynamics, and voice pattern. The first three are biological traits that use a part of the body for identification. The last two are cultural traits learned and modified during a person's life. The characteristics of these devices are discussed below.

Hand Geometry. Devices utilizing hand geometry as the authentication medium measure and record characteristics such as finger length, knuckle length and width, and the length of the webbing between fingers. An individual requesting access places the enrolled hand on a scanner plate that measures the data points.

Fingerprint Pattern. Verification devices based upon fingerprint pattern recognition have the advantage of recognition by the security industry and by the general population as a means of positive identification. Systems currently available have had no trouble gaining acceptance and would seem to be a good choice among the various biometric devices.

The largest problem with fingerprint pattern verification is in the scanning of the candidate's finger. Variations caused by too much or too little sweat, too little or too much applied pressure, incorrect positioning, dirty fingers, finger wear, or trauma to the fingertip present the verification device with a real task in determining the validity of an access request.

Circumvention of a fingerprint pattern recognizer would be done by the same method as for the hand geometry units. A synthetic fingerprint could be manufactured and used in place of the real fingerprint to gain unauthorized access.

Retinal Scan. There are some very good arguments for the retinal scan system. The retina is inside the eye, making counterfeiting very difficult. It also seems to be as unique a trait as is a fingerprint pattern. Of concern to some is the safety of the retinal scan system. The Food and Drug Administration (FDA) felt it unnecessary to certify the system due to the extremely low-level lighting used.

Signature Dynamics. A signature is a cultural characteristic that is considered as the major identifier for most financial transactions in our society. Thus, public acceptance for such a system is high. The long history of signature usage has also resulted in forgers acquiring the skills to duplicate signatures with a good degree of success. The manufacturers of signature dynamics have defeated the problems associated with using a static signature by relying on the dynamic motions of the pen as the signature is written to identify the writer. A candidate uses a pen on a pressure-sensitive pad to sign his name. The pad senses the pauses between parts of the signature, the length of time it takes to write the signature, and the different pressures used at different points. This information is used as the basis for user verification.

One of the concerns of this type of system is the length of time necessary to write one's signature. This probably makes it a less attractive system for use in high traffic areas or where the same individuals will be using the entries many times during one shift.

Voice Pattern. Voice recognition has existed for some time but has not been used for access control due to the nonrepeatability of identifiable features. Colds, laughter, and even moods change the voice enough to cause verification errors. New technologies using vocal features based upon the permanent structures of the head and throat promise better performance. One disadvantage of this system is the requirement for a noise-free environment for proper operation.

As more and more automatic access control systems are installed, the question of data security for the systems themselves becomes of concern. The data paths between biometric verification and of the devices and their central controller may be subject to penetration. To combat this, some companies are starting to offer data encryption at the terminal devices to maintain security of the system. The encryption algorithm used is the National Bureau of Standard's Data Encryption Standard (DES). If both the verification data and the access grant/denial communications are encrypted, an additional level of complexity is added to protect against a penetration attempt.

With the advent of secure distributed data processing and secure shared databases, the control of the access to a computer network is becoming just as important as physical access to a facility. Many of these same devices can be used as verification devices for data processing access control. There is, however, no standard that defines the interface of an access control device to a computer network. Each computer system user must develop his own interface to a particular access control device. Once the choice is made, it is very difficult to interface another device with different protocols and data storage requirements.

TEMPEST Signal Shielding

TEMPEST is an unclassified codeword referring to investigations and studies of compromising emanations. Compromising emanations are defined as information-carrying signals from electronic or electromechanical equipment processing national security information that could cause the security information to be revealed to unauthorized persons. For purposes of this discussion, consider that the signals originate from a point source as shown in Figure 7-23. The receiver (the unauthorized interceptor) is some distance away from the source. The ability of this receiver to detect a signal is based upon the strength of the signal, the sensitivity of the receiver, and the amount of ambient noise at the frequency being examined.

TEMPEST Countermeasures

Essentially, TEMPEST engineering means designing into a piece of equipment, a facility, or a combination thereof, enough attenuation so that any signals containing national security information cannot be detected by an unauthorized person at the nearest distance at which he can set up his detection equipment. The need for additional attenuation to achieve this in the receiving path is shown in Figure 7-24. Also shown is a secondary path that can be exploited. This is caused by conduction of a compromising emanation out of a controlled space by a conductor such as power line, a telephone line, the steel structure of a building, or extraneous wiring in the building. Such conductors must be filtered, decoupled, or isolated before they leave the controlled space. The accepted level of necessary attenuation is 100 decibels (dB).

The 100 dB attenuation level is usually specified for the frequency range from 14 kilohertz (kHz) to 10 gigahertz (GHz). This amount of attenuation has been judged to be sufficient for almost all installations requiring TEMPEST countermeasures and is usually implemented with a shielded enclosure built to the specifications contained in NSA Specification 65-6. One of the key attractions of this type of enclosure is that any electronic equipment can be installed in the enclosure without regard to the equipment's emanation characteristics. Usually, no additional testing is required once the enclosure has been tested to demonstrate the 100 dB level of attenuation.

Occasionally, the installation of a shielded enclosure may not be possible due to time, cost, or aesthetic/operational constraints, or the enclosure may simply not be necessary due to the amount of controlled space around a facility. In order to address these constraints, NSA has promulgated National COMSEC Information Memorandum (NACSIM) 5004 (S), TEMPEST Countermeasures for Facilities within the United States (U); and NACSIM 5005 (S), TEMPEST Countermeasures for Facilities Outside the United States (U). These documents provide guidance and a methodology for determining the use of less costly countermeasures such as RED/BLACK separation and isolation and use of equipment that has been characterized according to its emanations.

Two points must be emphasized about the application of this guidance to a facility requiring TEMPEST countermeasures. The first is that most applications are not straightforward and thus may require the assistance of a knowledgeable engineer or technician in order to ensure that the requirements are met. The second is that the only method of certifying that a facility does not have a TEMPEST problem is to conduct a TEMPEST test. This is because there are many possible sneak paths that signals may follow, or inadvertent circumventions of shielding and filtering by unknowing personnel that may not be found during routine inspections.

The test standard used for TEMPEST testing of all kinds is National COMSEC Information Memorandum (NACSIM) 5100A (C), Laboratory Test

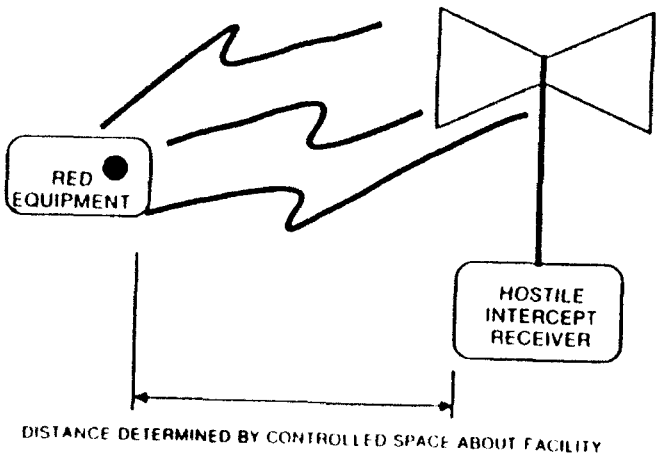


Figure 7-23. Radiated Compromising Emanations Problems

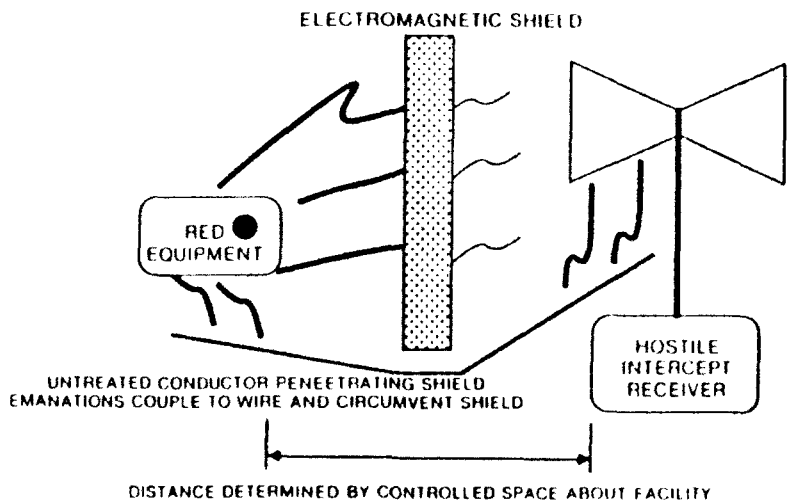


Figure 7-24. Tempest Attenuation Problems

Standard for Compromising Emanations, Electromagnetics (U), July 1981. This document contains the test procedures, documentation requirements, and test limits for TEMPEST certification of equipment. The test methodology is very precise and requires a knowledge of the equipment operation as well as an understanding of TEMPEST phenomena.

TEMPEST countermeasures can be applied at many different levels. Each application must be judged separately based upon the level of threat, the importance of the information that could be compromised, and the economics of the candidate countermeasures. It cannot be stressed too highly that this judgment is best made by qualified personnel in conjunction with government approving authorities.

In keeping with the perceived need for qualified personnel, NSA has recently started a TEMPEST certification program for engineers and test technicians. The result of this program should be higher quality equipment for TEMPEST use, better quality assurance control during equipment manufacture, and ultimately, greater assurance to the user that TEMPEST equipment in fact meets the requirements of national security.

Delineation of Interior Levels of Security

Some fundamental security procedures are required for areas containing equipment that process national security information. The adoption of physical security standards and procedures in accordance with current directives is the user's responsibility. It is recommended that local security officials and others responsible for building construction or modification be contacted in the planning stages of all projects. Security measures adopted must be effective, practical, and compatible with local policies. To provide for such conditions, in-depth security measures should be established.

To address the different levels of security sensitivity and yet provide the type of protection required, three types of security areas have been designated: controlled, limited, and exclusion. The following definitions are those commonly used in physical security guidelines. Also, physical security nomenclatures apply to physically delineated spaces, whereas the equivalent engineering-installation terms are often delineated only on plans. The terms therefore are not necessarily interchangeable.

- A controlled space is the space surrounding equipment for processing classified information, within which unauthorized personnel (1) are denied unrestricted access, and (2) are either escorted by authorized personnel or are under continual physical or electronic surveillance.

- A limited area (limited exclusion area) is an area containing classified information or equipment in which controlled movement would permit access to such material, but within which access may be controlled by escort and other internal restrictions.
- An exclusion area is an area containing classified information or equipment which is of such a nature that constitutes, for all practical purposes, access to classified material.

The following guidelines, though not inclusive, pertain to areas inside a facility in which classified information is processed.

Accountability of wires and cables

Complete accountability should be required for all wires and cables in, or passing through, a secure area. All extraneous wiring should be removed. Unused wiring in cable should be grounded in the controlled area.

Construction features

Exterior construction should be designed to prevent surreptitious entry. All passages (doors, windows, and vents) into the area should be equipped with hardware that provides security comparable to the exterior walls, floors and ceilings. Construction methods and materials, as well as the protective measures required, depend on the sensitivity of the information processed in the area.

Adjacent secure areas

Such areas should be viewed as separate entities unless they are of the same classification level and subject to the same personnel access standards.

Guards

Guard personnel for a protected system should have security clearances commensurate with the class of information protected in their duties. Guards may be assigned to stationary or roving patrol posts. They should be formally charged with ensuring the area's security. Guards may, in general terms, be told what they are guarding, as the equipment and information in these areas must be protected by other, more direct physical means than those established through normal building guard systems.

Security during construction

Construction and modification of buildings anticipated to house and protect national security information processing facilities are sensitive matters. This sensitivity is increased because uncleared persons are usually employed in the construction or modification processes. The construction period could provide an opportunity for covert devices to be installed or for building materials to be improperly installed, either of which would weaken the installation's security. Properly cleared, qualified engineers or technicians should supervise and inspect the work. Security is vulnerable during the entire construction process; however, particular care should be taken during the finishing phase to prevent covert listening devices from being hidden in walls, behind partitions, or above false ceilings.

Installing and maintaining a shielding system to contain all telecommunication emanations involves: (1) selection of an effective enclosure; and (b) appropriate isolators and filters.

Selection of an Effective Enclosure

To contain emanations from telecommunications, there are three preferred types of enclosure: steel, armored plywood, and aluminum foil. Later in this section, these will be discussed individually in detail. The three types will first be compared with regard to three capabilities: attenuation of radiated emanations; fundamentals of construction; and installation characteristics.

Attenuation of radiated emanations

The selection of shielded enclosures should be based on information, classification, user requirement, and geographical location of the facility (CONUS and overseas), on ability to control the area immediately around the facility, and on the TEMPEST characteristics of equipment to be used. Since the purpose of the enclosure is to attenuate all forms of both conducted and radiated emanations, the actual equipment-installation requirements within the enclosure are the responsibility of the engineering-installation agency.

A comparison of steel, armored-plywood, and aluminum-foil enclosures follows:

- Magnetic fields—H fields—and electric fields—E-fields—are attenuated through absorption and reflection losses. H-field losses occur mainly because of the absorption of energy by magnetic materials such as steel. The H-field loss in steel largely depends on the thickness of the material;

consequently, of the three enclosure types, steel provides the most H-field shielding. Armored plywood enclosures can increase H-field shielding-effectiveness by increasing the thickness of the armor. Aluminum-foil enclosures exhibit poor H-field shielding, due to the thinness of the foil and to the fact that it is a nonferrous material.

- In contrast to H-field losses, E-field losses are largely the result of reflection of energy off the enclosure surfaces. Both steel and armored-plywood enclosures provide similar reflecting surfaces and, therefore, have similar E-field attenuation values. Aluminum foil also has a good reflecting surface, which results in moderate E-field attenuation values. The maximum obtainable attenuation values for any enclosure depend largely on the quality of construction.

Fundamentals of Construction

The primary resource for information about TEMPEST facility construction requirements and standards is TEMPEST Fundamentals NSA-82-89 NACSEM 5000.

The shielding effectiveness of any enclosure depends on the electrical continuity between the various parts of the room. Ideally, the enclosure should be a continuous, six-sided sheet of metal. However, certain openings—doors, air vents, and penetrations for pipes and electrical lines—are essential. A door is potentially the weakest point of any enclosure. Although a closed door should provide as much attenuation as the rest of the structure, to be effective it must form an electrical continuity between itself and the rest of the enclosure. Enclosure doors, therefore, must be constructed sturdily to prevent any sagging or warping that could lead to leakage. Air vents should be made from waveguide sections, bonded together to form a grill that is electrically bonded to the enclosure. For the same frequencies, each waveguide section, acting as a high-pass filter, provides at least as much attenuation as the enclosure. A conductive line or duct should use 6-inch nonconductive coupling outside the enclosure, as close to the wall as possible, preferably less than 2 inches away.

It is relatively easy to achieve the required shielding effectiveness in a welded box without openings and penetrations. However, to preserve this performance in a real facility with numerous penetrations requires careful attention to each of the potential leakage points. The table depicts a shield-penetration schedule, typical of the specifications that must be written into contract documents for a communication facility.

A comparison of steel, armored-plywood, and aluminum-foil enclosures follows:

- Construction of a steel enclosure is the most elaborate since specialized tools and labor are necessary. Both armored-plywood and aluminum-foil enclosures can be assembled with only common tools and labor. Aluminum-foil enclosures have an additional advantage: they use commonly available materials. On the other hand, the panels and hardware for both steel and armored-plywood enclosures must be supplied by an enclosure manufacturer. Foil enclosures take more time to construct than other types, especially when inexperienced help is employed.

Installation Characteristics

Three installation characteristics that can influence the choice of an enclosure are: location, floor loading, and portability.

Location of a shielded enclosure within an enclosing room—a parent room—can minimize potential weak points. Since doors potentially are weak areas of an enclosure, locate each door in an area near the center of the control zone where leakage will be least detectable. Locate the enclosure where the fewest penetrations will be necessary; find an area with the fewest pipes, ducts, and so forth to interfere with construction; each penetration is a possible leakage point. The enclosure walls should be at least 18 inches from the parent room's walls, to facilitate construction, testing, inspection, and maintenance of the enclosure. If an 18-inch separation is impractical, precautions are needed to prevent clandestine probing or penetration possibilities. Attempt to locate the enclosure close to a grounding point to avoid long ground wire runs. Ground the enclosure to an earth ground at the main power entrance panel. When an earth ground is not feasible, use a connection to a-c ground external to the enclosure.

With regard to floor loading, the weight of some enclosures, especially solid steel enclosures, will limit the placement to ground level floors or will require additional floor supports. Determine the floor loading limits of the enclosure site, to insure that the floor can support the enclosure. Portability is a necessary consideration when constantly changing circumstances require a regular expansion or relocation of an enclosure. For such a situation, consider an enclosure that can be enlarged or moved as easily as possible.

A comparison of steel, armored-plywood, and aluminum-foil enclosures follows:

- Construction costs for any enclosure include both material costs and labor costs; the latter usually is the major part. For smaller rooms (up to 16-foot width), armored-plywood enclosures usually will cost less than steel. For greater than 16-foot widths, steel and armored-plywood enclosures usu-

ally are competitive, for additional ceiling supports for armored-plywood enclosures often are necessary. Although aluminum-foil enclosure-materials cost less than other enclosure-materials, labor costs to construct an aluminum-foil enclosure can offset any savings in material costs. If in-house labor is available, a relatively inexpensive aluminum-foil enclosure can be constructed. In-house labor also might be used to build an armored-plywood enclosure that has been shipped from the manufacturer to the installation site as a complete materials-package.

- If additional building components such as floor supports are necessary to bear the additional weight, installation costs increase for steel and armored-plywood rooms. Also, for these, a minimum distance of 18 inches between enclosure and parent-room wall is suggested for work space and inspection. Armored-plywood enclosures when bolted from the inside eliminate the need for work space between the enclosure and parent-room walls. Aluminum-foil enclosures require no work space between their own walls, but their installation costs must also include some protective covering for the foil surfaces.
- Generally speaking, a shielded enclosure can be moved after it is installed, but this can entail a high labor cost. An armored-plywood enclosure is the most portable kind. It can be assembled and then disassembled and moved. Aluminum-foil enclosures are not portable.
- Maintenance cost for a steel or aluminum-foil enclosure will be low if it is properly constructed. An armored-plywood enclosure requires frequent inspection and the repair of damaged or corroded door surfaces and loosened seam bolts.

Steel Enclosures

This begins a more detailed discussion of each of the types of enclosure.

A steel enclosure is constructed from steel panels of 16-gage to 3/8-inch thickness, welded at the seams to a steel beam superstructure. Special heavy equipment and skilled labor is required to assemble the room properly and quickly, increasing the overall cost. Enclosure doors are often massive; hydraulic assistance is then needed not only to operate the door, but also to maintain an even metal-contact pressure around the frame.

Steel enclosures provide these typical attenuation characteristics:

- Magnetic-field (H-field) attenuation: 30 decibels at 30 hertz, up to 100 decibels at 1 kilohertz. Continue 100 decibels to 1 megahertz. H-field attenuation values decrease with decreasing steel thickness.
- Electric-field (E-field) attenuation: 100 decibels from 30 hertz to 100 megahertz.
- Plane-wave attenuation: 100 decibels from 100 megahertz to 10 gigahertz.
- Acoustic-waves attenuation: 12 decibels at 4 hertz to 59 decibels at 7 kilohertz. Acoustic-wave attenuation characteristics apply only to RF enclosures treated with acoustic absorbing material, not to standard RF enclosures.

When positioning a steel enclosure, external walls should be made accessible for welding the steel panels to the frame. Optimally, there should be at least 2 or 3 feet between the enclosure and parent-room walls for work-space and inspections.

With steel enclosures, floor loading becomes a major consideration. The weight of a steel enclosure demands a sturdy foundation and careful measurement of the load-limits of the parent-room floor.

Consider the steel enclosure a permanent installation. Although the enclosure conceivably can be moved, the effort and cost may well be prohibitive.

The construction, material, and labor cost of a moderate-size steel enclosure (under a 10-foot ceiling) will be more than that of other types of enclosures. If the enclosure has a width over 24 feet, a steel enclosure may be more cost effective than an armored-plywood enclosure.

Installation costs for steel enclosures may be increased if additional floor supports are necessary to strengthen the floor that bears the weight of the enclosure.

Maintenance costs for solid steel enclosures are usually minimal. Welded seams maintain electrical continuity indefinitely, under all types of environmental stresses. Massive doors, however, can produce leakage, from sagging or surface corrosion that prevents proper sealing with the frame.

Testing costs are about the same as for the other types of enclosure.

At the initial inspection of the enclosure:

- Make sure that welded joints are complete, with no gaps or cracks along the seams.

- Examine the door for complete sealing around the frame. Solid steel rooms usually do not use finger stock. See that the surfaces are clean and free of mars or grooves.
- After external power lines are connected to the filters, check all filters for damaged seals and for missing or loose lids. Ensure that filter cases are mounted with a good electrical bond to the enclosure wall.
- Examine penetrating pipes and ducts and their bond to the enclosure. Ensure that a nonconducting section is placed outside the enclosure, along the penetrating item, to isolate it from the enclosure.

At each periodic inspection of the enclosure:

- Inspect to see that the enclosure has not been affected adversely by settling and environmental changes. Any problems with the access-door closing and sealing operation can require major repairs.
- Inspect the roof to detect any sagging, any broken welds, and so forth, that may produce leakage.
- Inspect any door frames containing finger stock. Inspect other types of door frames for clean smooth surfaces, free of such problems as nicks and dirt that may cause a poor seal.
- Inspect any doors using finger stock. Inspect doors using RF gasketing or some other sealing method, for such problems as wear, pitting, tears, and gaps that may cause a poor seal.
- Inspect the filters for leakage of the potting compound. RF leakage may occur if the hardware between the shield and the filter has worked loose, or if there is a poor electrical bond between the filter case and its lid. If the lid is dented or loose, it should be replaced. If the filter is leaking potting compound, an oily or viscous material oozes from the seams in the filter case. The physical properties of this material vary with the manufacturer, but any visible exudation indicates a potentially defective filter. Causes may be overheating from current overload, internal defects, or poor air circulation.
- Inspect and clean the air filters covering the ducts, especially if the opening of the duct is near the floor.

Armored-Plywood Enclosures

An armored-plywood enclosure is constructed from panels made of 24-gage steel sheets (or thicker) bonded to both sides of 3/4-inch plywood. The panels are 4 feet wide, and can be 8 feet or 10 feet long. The panels are bolted together using steel-channel pressure-plates and large-diameter bolts, torqued down to provide even metal contact for electrical continuity. Construction of an armored-plywood enclosure does not require the specialized equipment or labor necessary for steel enclosures. Doors can be operated manually or automatically. Electrical contact between a door and frame is made by using bronze or copper contact-strips-finger stock—around the door jamb. Upon closing, these strips uniformly contact a copper or brass door buck to form a seal.

24-gage-steel armored-plywood enclosures provide these typical attenuation characteristics:

- Magnetic-field (H-field) attenuation: 20 decibels at 1 kilohertz to 100 decibels at 1 megahertz.
- Electric-field (E-field) attenuation: 70 decibels at 1 kilohertz to 100 decibels from 10 kilohertz to 100 megahertz.
- Plane-wave attenuation: 100 decibels from 100 megahertz to 10 gigahertz.
- Acoustic-wave attenuation: 12 decibels at 4 hertz to 59 decibels at 7 kilohertz. Acoustic-wave attenuation characteristics apply only to RF enclosures treated with acoustic absorbing material, not to standard RF enclosures.

For armored-plywood enclosures bolted from the outside, there should be at least 18 inches between the walls of the enclosure and those of the parent room. This facilitates installation and inspection. Some enclosures are bolted from the inside and avoid this space requirement; such an arrangement, however, also prevents periodic inspection of the external walls of the enclosure.

Heavy loading of the parent-room floor can be a problem with armored-plywood enclosures. Include the extra weight of the enclosure when calculating floor-load limits.

Armored-plywood enclosures can be adapted to changing space requirements. Additional panels may be added for expansion or the entire room disassembled, moved, and reassembled.

Standard rooms, as defined here, have a length in multiples of 4 feet, a width less than 24 feet, and a ceiling 8 or 10 feet high. For a standard room, materials and labor costs for the construction of armored-plywood enclosures usually are less than those for steel enclosures. Armored-plywood enclosures

come in kit-packages that can be assembled by local unskilled labor, potentially reducing construction costs. A cautionary note: inexperienced labor may degrade attenuation levels by assembling the enclosure improperly.

Installation costs can be moderate, for unusual floor-load precautions usually will not be necessary. An armored-plywood enclosure also is usually more cost-effective when the enclosure is moved or expanded frequently.

Maintenance costs, however, may be greater than for other types of enclosures. Armored-plywood enclosures are susceptible to loosened seams and sagging roof panels. Frequent inspection of the enclosure is necessary, especially after installation, to detect loose bolts. Any loose bolts must immediately be retightened to uniform specified torque; the bolts then must be tested for leakage. Doors require continuing maintenance—replacing damaged or missed finger stock, repairing sagging doors, and cleaning corroded door and seam surfaces.

Testing costs are about the same as for the other types of enclosure.

At the initial inspection of the enclosure:

1.Look for crooked joints in the framing, and for missing bolts. Check the roof for sag.

2.Examine the door for bent, missing, or dirty finger-stock contact. Check the frame for dents, deep scratches, or corrosion.

3.Check the filters. (For procedure, see the section on "Steel Enclosures.")

4.Check the enclosure-penetrations. (For procedure, see the section on "Steel Enclosure.")

At each periodic inspections of the enclosure:

1.Inspect for loose joints. After an armored-plywood enclosure has been used for a few months, settling of the enclosure or the parent room can loosen the joints. Repeated expansion and contraction from changing atmospheric conditions can cause the wood in the panels to lose its elasticity. Usually loose joints cannot be detected by visual inspection only. Examine the exterior surfaces of the enclosure for bulges, distorted framing, or signs of corrosion.

2.Inspect the roof for sagging. If sagging is found, determine the amount.

3.Inspect the door-frame contact-pattern—a good indicator of potential RF leakage. This pattern consists of marks or scratches made by the metal door fingers.

- If the scratches are evenly spaced and of approximately equal depth, and if the fingers and the door frame are clean and shiny, RF leakage is unlikely.
- If the contact pattern is deep at one corner and gradually fainter toward the opposite corner, the door is probably sagging at the hinges; RF leakage is likely to occur where the pattern is faint.
- If there are irregular light spots, the fingers at corresponding points on the door are probably flattened or missing. Leaking is almost certainly occurring at these points.
- If there are deep gouges in the door frame where the frame touches the latching mechanism, these can provide leakage-paths for high-frequency signals.
- If there are dents or severe wear near the handle, this usually indicates a misaligned latch.
- If there is dust or corrosion, these are poor conductors, and are sources of RF leakage.

4.Examine the door's finger stock for damage and corrosion, especially at points corresponding to any light contact patterns on the door frame. Broken or bent fingers are found most often at the corners of the door and in the latch area. Examine the accessible parts of the latching mechanism for wear; operate the door to detect binding or scraping. If there is an emergency escape hatch that can be opened easily—without major repairs necessary to close it—inspect and operate the hatch every 6 months. Inspect each hinge for sag, by measuring the spacing between the hinge-pin and the frame: spacing should be uniform along the pin.

5.Check the filters. (For procedure, see the section on "Steel Enclosures.")

6.Check the filters covering the ducts. (For procedure, see the section on "Steel Enclosures.")

Aluminum-Foil Enclosures

An aluminum-foil enclosure is made by covering a wooden frame with aluminum-foil sheets. For the walls and ceiling, the wooden frame can use 2 x 4 studs, 1 x 4 furring strips, and 1/2-inch plywood. It should have an 18-gage

sheet steel floor. Four-foot wide, 2.5-mil thick embossed aluminum-foil sheets should be used to cover the wall- and ceiling-frame, in two overlapping layers. Each foil layer should be stapled to the frame, and the bottom edge should be pressed against the sheet-steel floor by a steel bar, to form a complete metal shell. Construction requires no specialized tools or labor, but takes more time than for prefabricated enclosures of steel or armored-plywood. Extra care is necessary to avoid rips and sloppy construction. The enclosure doors are made of steel panels with steel frames, and are sealed with standard closer mechanisms. To reduce door leakage, a vestibule entrance arrangement with two sets of doors can be used in place of costlier custom-made enclosure doors.

Aluminum-foil enclosures provide these typical attenuation characteristics:

- Magnetic-field (H-field) attenuation: 10 decibels at 1 kilohertz to 50 decibels at 1 megahertz.
- Electric-field (E-field) attenuation: 50 decibels at 10 kilohertz to 100 megahertz.
- Plane-wave attenuation: 50 decibels at 100 megahertz to 40 decibels at 1 gigahertz.
- Acoustic-wave attenuation: depends on the acoustic treatment used within the enclosure. Acoustic-wave attenuation characteristics apply only to RF enclosures treated with acoustic absorbing material, not to standard RF enclosures.

Except for wooden framework as may be required, an aluminum foil enclosure is attached directly to existing parent-room walls. No space is required between enclosure walls and parent room walls. The door location for aluminum-foil enclosures is especially critical since special radiation-tight doors are not used and leakage is probable at high frequencies. Consequently, locate doors toward the most secure area of the parent room—toward the center of the secure perimeter. If there is no space for vestibule entranceways, either seal the door with finger stock or use a manufacturer door.

Floor-loading is not a critical consideration for aluminum-foil enclosures, for all materials are lightweight.

An aluminum-foil enclosure has no portability. Although the enclosure is easily razed, building materials cannot be reused. The enclosure can be expanded by adding to the wooden frame and adding more foil.

Material-cost for an aluminum foil enclosure is less than for any other enclosure. The costliest item is labor; and labor-cost, if not controlled, can offset the savings in material-cost. The use of in-house labor can avoid this problem. The foil sheets are cheap, as are the staples, wooden frame, and so on.

Installation costs must include a protective covering over the foil—essential to prevent tears in the foil. Inexpensive drywall may be used as a covering.

Maintenance cost for a well-constructed aluminum foil enclosure probably will be low. The main maintenance will be the repair of tears in the foil. Protective cover of the walls and ceiling (see above) are essential to minimize maintenance. The ceiling should be inspected periodically for sagging foil panels, and for tears around the metal staples.

Testing costs are about the same as for the other types of enclosure.

At the initial inspection of the enclosure:

- Inspect the construction before the installation of any protective wall, ceiling, or floor surface.
- Check the roof panels for sag; the foil-wall to steel-floor connection; the overlapping seams; and the continuous bend of foil at corners.
- Check spot welds on steel floor seams and continuous welds at all vertical seams in the steel floor.
- Inspect doors for proper closing operation; clean the contact points between the frame and the door. Double doors should have a metal strip covering the space between the doors.
- Inspect the filters. (For procedure, see the section on "Steel Enclosure.")
- Examine enclosure penetrations. (For procedure, see the section on "Steel enclosures.")

At each periodic inspection of the enclosure:

- Inspect for tears in the foil panels, the main problem with this type of enclosure. Once a protective wall surface is installed, inspections are easy to make. If suspended ceiling and raised floors are used, periodic inspection of foil panels and steel floors is advisable.
- Inspect the ceiling for sagging or torn foil panels, and for loosening seams. The steel floor should be free of rust and corrosion.

- If a special-order enclosure-door with finger stock is used, inspect the door frame and doors as described in the section on armored-plywood enclosures. Usually, for this type of enclosure, door openings use steel panel doors and steel frames. Contact points between the frame and the door should be as clean as possible. Inspect the door closely to determine that in operation, there is contact pressure between the door and the frame.
- Examine the filters. (For procedure, see the section on "Steel enclosures.")
- Inspect the air filters. (For procedure, see the section on "Steel enclosures.")

Alternative Measures for Containing Emanations

An enclosure may not be the most cost-effective way to contain emanations from telecommunications. In many cases, equipment or system modification may be possible to reduce the C-E to a level that can adequately be contained within available control-zone boundaries. Also, a change in system components or a modification in equipment may eliminate or reduce C-E enough that an aluminum-foil enclosure can be used. The choice of system or equipment modifications will depend on the availability, price, and quantity of modifications needed.

To provide TEMPEST security, a change in the control zone may be more cost effective than the building of an enclosure or the modification of equipment and systems. In a trade-off, the control zone might be expanded enough to permit the use of an aluminum-foil enclosure.

Knowing the control zone perimeter necessary for TEMPEST security, consider the trade-offs available. Expand the control-zone perimeter to the distance needed to minimize the hazard; or,modify or replace the hazardous equipment and system; or, combine these choices in the most cost-effective manner.

A number of commercial firms manufacturer several types of shielded enclosures. These firms also make enclosure parts such as doors, filters, and waveguide grills. The listing below is not an endorsement by the NSA of any or all of these firms, nor should it be regarded as complete.

Ray Proof Corp., Norwalk, CT—Armored plywood.

ARK Electronics Corp., Willow Grove, PA—Steel rooms.

All-Shielded Enclosures, Inc., Westbury, NY—Steel rooms.

Total Spectrum Engineering Corp., Huntington Beach, CA—Steel rooms.

Universal Shielding Corp., Plainville, NY—Steel rooms.

Isolators and Filters

Conducted C-E on signal, control, or power lines may originate in a piece of equipment or be coupled onto a line when that line passes through a strong electromagnetic field. Filters are commonly used to reduce or eliminate conducted C-E from black conductors. To work effectively, a filter must be well-grounded to the C-E signal source-reference. A shielded enclosure can provide the grounding needed for a filter. If a filter is mounted on an enclosure, this eliminates the potential for C-E coupling onto a conductor when the conductor must penetrate the shield. Optical isolators also provide very good electrical isolation. These devices avoid the conduction of C-E signals from an enclosure by using a nonconductive optical link. Isolators are more expensive than filters, but they provide better isolation with fewer installation problems. A shielded enclosure can be neutralized by failure to filter or isolate lines penetrating the shield—for radiated signals within may couple onto lines and be conducted outside the shield. The amount of filter-isolation-attenuation needed depends on the level of shielding required for radiated signals. Since radiated-fields couple onto signal-lines and signal-lines radiate, the amount of conducted signals attenuation should be based on the amount of radiated-signal attenuation.

Isolators

An isolator consists of a send/receive unit, coupled to a fiber-optic transmission line, coupled to another send/receive unit. The send-unit converts electrical energy into light-energy, then transmits it through the fiber-optic line. The receive-unit converts the light-energy back to electrical energy. In a shielding installation, the isolator is installed on the wall of the enclosure—a send/receive units installed inside, another outside the enclosure. The fiber-optic line passes through the wall of the enclosure in a waveguide opening, connecting the send/receive units.

Analog isolators are one alternative to the use of telephone-line filters. These isolators can provide 100 decibels or more of isolation outside the audio frequency range.

Digital isolators also provide 100 decibels or more isolation for digital signals from d-c to 6.3 MB/s. A digital isolator passes only the intended digital signal, while blocking any coupled digital energy from other devices.

The use of administrative telephones within the shielded enclosure is discouraged. If, however, administrative telephones must be used there, optical isolators must be approved by the cognizant engineering activity before installation.

Filters

Low-pass filters allow intended signals to pass, while attenuating the high-frequency unintended C-E signals. In shielded enclosures, low-pass filters are used for power-lines, control-lines and signal-lines that penetrate the shield. The attenuation that a low-pass filter provides for conducted signals should be in the same magnitude and frequency range that the enclosure provides for radiated signals. Specifically, then steel and armored-plywood enclosures, require filters providing 100-decibel attenuation up to a frequency of 10 gigahertz, aluminum-foil enclosures require filters providing 50-decibel or greater attenuation up to a frequency of 1 gigahertz. Some installations may have higher attenuation requirements for filters, but these can be decided on a case-by-case basis.

Filters used in an enclosure must have a sufficient power rating to handle the current demands for the entire installation—including lights and system equipment. Excessive current drawn on log-power-rated filters may degrade the filter's attenuation characteristics. When installing filters, consider both present and future power requirements.

Regardless of a filter's attenuation rating, it cannot achieve its full attenuating characteristics without a proper ground connection. For optimum results, a filter's case must be well-bonded electrically to the enclosure's metal surface.

Excessive voltage drop, overheating, and leakage are the most common signs of defective filters. After removal of a defective filter, clean the feed-through connectors on the panel with steel wool. Install the new filter carefully, to insure good RF continuity between the filter and the panel. If the filter is equipped with a lid, the lip of each lid and the corresponding surface of the filter case must be flat, free from scratches, and cleaned with steel wool. Soldering the lid to the case insures a good RF joint, but the manufacturer should first be asked whether the soldering heat will damage the filter.

RF leakage at the filter panel is usually caused by corrosion at the junction between the filter and the panel, or between the lid and the filter case. Either problem may be corrected by cleaning the contact surfaces with steel wool, and reinstalling the filter.

Acoustic leakage at the filter panel is usually caused by unintentional metal-to-metal contact between the acoustic-filter cover and the outer shield. Replacement of acoustic gaskets between the metal surfaces should correct this problem.

Sources of isolators and filters:

A number of electronic firms manufacture several different types of filters and isolators. A few of these firms are listed below. The listing should not be considered an endorsement of any or all of these firms, nor should the list be regarded as complete.

Erie Technological Products, Inc., 644 West 12th Street, Erie, PA 16513

Filtron Manufacturing Co., Inc., 6 Aerial Way, Syosset, NY 11791

RF Interonics, 100 Pine Aire Drive, Bay Shore, NY 11706

Sprague Electric Co., 97 Marshall Street, North Adams, MA 01247

Versitron, Inc., 6310 Chillum Place NW, Washington, DC 20011

INTERIOR FINISHES

The interior construction of the command center divides interior space for functional use. Interior construction consists of floor/ceiling assemblies and wall/partitioning assemblies. Floor/ceiling assemblies divide space in the vertical direction; wall/partitioning assemblies divide space in the horizontal direction. Both assemblies divide the interior space of a building into functional units.

Flooring treatments must conform to all applicable standards and methods of construction and maintenance. They must:

- Resist abrasion, indentation, and tensile and shearing stresses
- Allow maintenance at limited cost
- Resist slipping
- Maintain life safety standards
- Limit the accumulation of static charge where appropriate
- Provide enhanced comfort where appropriate
- Limit the transmission of impact noise between floors
- Provide adequate sound absorption
- Provide access to building utilities and equipment where appropriate
- Provide for the relocation of partitioning and traffic patterns.

Wall finishes must conform to all applicable standards and methods of construction and maintenance. They must:

- Meet light reflectance requirements
- Provide ease of maintenance
- Resist abrasion and impact
- Show clearly how any attempt at surreptitious entry
- Maintain life safety standards.

Ceiling systems must conform to all applicable standards and methods of construction and maintenance. They must:

- Resist deflection
- Accommodate expansion and contraction
- Maintain life safety standards
- Accommodate building deflections
- Resist heat flow
- Limit sound transmission
- Accommodate lighting and HVAC.

Floors

Flooring is the surface component of a floor that resists wear. It should be durable and safe, easily maintained, and aesthetically pleasing during the life of the floor assembly. Flooring should be installed at an acceptable in-service cost, according to appropriate building standards.

Flooring is subject to traffic, moisture, abrasion, indentation and impact, tensile and shearing stresses, and chemicals. Flooring must be installed according to appropriate building standards.

- Some traffic is uniformly distributed over the floor surface; some is localized, such as at entrances, along traffic aisles, or in stairwells.
- Common sources of moisture are: water spills and wet cleaning; ground water or water vapor migrating through the substrate; condensation of water vapor under hot, humid conditions; and rain, snow, and ice.
- Abrasion can come from wet or dry dust, and from dirt rubbed over the surface by foot traffic. Scratches can be caused by hard objects such as cinders brought in by foot traffic.
- Indentation can be caused by spiked heels, heavy objects, or the impact of dropped objects.
- Tensile and shearing stresses develop in the flooring as a result of differential thermal expansion and contraction. This may be caused by a difference in coefficients of thermal expansion in the substrate and in the flooring, or by a temperature differential between the two. These stresses also can develop: from shrinking or swelling in the floor; from moisture;

from movement in the joints of a substrate; from bending stresses when the flooring has to bridge voids; and from excessive deflection in the substrate.

- Flooring must withstand chemicals—in cleaning solutions, spilled in or around industrial uses, or washed out of polluted air by rain or snow. Building standards generally specify flame-spread and smoke-density requirements.

The following criteria should be used to make a flooring selection:

- Flooring material should be appropriate to the use and traffic it will receive.
- Maintenance should not require special techniques or equipment.
- Different floor materials require different depths for the substrate. Adequate transition between levels should be provided. Where different types of flooring meet, the transition should be specified. Expansion and contraction of the floor material and substrate should be considered.

Flooring types to be considered are hard flooring, resilient flooring, or carpeting.

Hard Flooring

Hard flooring uses permanent materials and usually is more costly—but it is very durable. (See Figure 7-25 for floor covering types.)

Cementitious flooring includes both monolithic concrete and cementitious topping. In monolithic concrete, flooring and substrate comprise one unit; this is the least expensive, but is limited in performance characteristics. Cementitious flooring consists of a mixture of aggregate and cementitious binder. The type of aggregate will largely determine the characteristics of the flooring. It may be selected for durability only, or for both durability and appearance. The top surface of the slab or topping can be steel troweled to serve as the wearing surface. The properties of the wearing surface are largely dependent on the mix of concrete used, its curing and finishing. The surface of smooth finished-slabs may be hardened by working selected aggregate into the top layer of the freshly poured concrete, or by using commercially available hardeners; coloring pigments may also be added and various decorative surface finishes are available.

Cementitious topping is a thin concrete slab poured over and bonded to concrete base slab. Selected aggregate, special finishing and curing methods are used to produce hard, dense, wear resistant surfaces. Both monolithic concrete and concrete topping are used when a durable inexpensive flooring is required. Topping, even though more expensive, provides better service than monolithic hardened-surface slab. A more expensive select aggregate can be used in the topping, without unduly increasing the cost. Placement and finishing are easier and can be better controlled.

Burned-clay flooring is made of a variety of clays in diverse shapes, patterns, and colors. Colors may be integral with the clay body, or applied as a glaze. Though expensive, this flooring is useful for indoor and outdoor locations where resistance to wear and moisture, appearance, and low maintenance costs are important. Clay tile is used: where chemicals, grease, and water may be frequently spilled; where sanitary conditions must be maintained; and in areas subject to freezing.

Ceramic tile is available in two classes, glazed and unglazed. Tile is made of clay, or a mixture of clay and other organic materials. These are fired in a kiln at temperatures above red heat. Porcelain is dense, fine-grained, and smooth. Its colors are usually clear and luminous. Natural-clay tile is dense, with a slightly textured appearance.

Resilient Flooring

Resilient flooring is available in sheets and in tiles. It can be made of various materials. (See Figure 7-26 for properties of common materials.) Most materials are resistant to moderately heavy traffic. Some are also grease resistant. Even if the flooring itself is moisture-resistant, it may fail if the bond between it and the substrate is weakened or destroyed by moisture seeping in through joints between units.

Resilient flooring is made up of various resins, plasticizers, fibers, pigments, and fillers. It is formed under heat and pressure. It is suitable for indoor locations only, in dry locations subject to moderate wear from foot traffic and rubber-wheeled traffic. Resilient flooring provides greater underfoot comfort than does stone, cementitious, and burned-clay flooring. Foam-backed types provide a high degree of resiliency. The readily available types of resilient flooring include linoleum, rubber, and homogeneous vinyl.

- Linoleum has a wearing layer of oxidized linseed oil or other oleoresinous binders, pigments, and mineral fillers attached to a backing of burlap or asphalt-saturated felt. Linoleum has very good resistance to grease and abrasion, but poor resistance to alkalis. It is available in two thicknesses: light gage for residential flooring and heavy gage for commercial installa-

MATERIALS	ADVANTAGES	DISADVANTAGES	USES	COST
Ceramic tile	Waterproof, resistant to most chemicals	Cold; not resistant to excessive heat	High moisture areas, kitchens, bathrooms	Moderate
Quarry tile	Waterproof; easily cleaned	Hard; matte finish	High moisture, heavy traffic areas	Economical
Concrete	Can be painted or treated	Will give off dust if not treated; difficult to clean	Utility flooring	Economical
Concrete (treated)	Nonconducting, nondusting and nonslip; abrasion resistant	Requires special materials and methods of application	Industrial and manufacturing areas where non-sparking required	Economical
Quarry tile (polished, smooth finish)	Waterproof, resistant to grease and liquids	Non resilient, may break under impact	Heavy traffic areas, kitchens	Moderate
Terrazzo (all types)	Durable in extreme weather conditions	Slippery when wet	Heavy traffic areas, stairs, entries	Expensive
Wood	Relatively easy to clean and refinish	Not resistant to abrasion or moisture	Dry indoor locations	Moderate to expensive

Figure 7-25. Hard Flooring Materials

MATERIALS	ADVANTAGES	DISADVANTAGES	USES	COST
Asphalt tile	Resistant to chemicals and staining	Requires fairly smooth floor surface; cannot be used in high moisture areas	General utility flooring	Economical
Conductive tile	Dissipates static electricity	Sensitive to extreme temperatures	Hospitals, computer rooms, chemical labs	Expensive
Rubber	Resilient, resistant to impact and abrasion	Not resistant to grease and chemicals	General utility flooring; stairs	Moderate
Vinyl asbestos tile	Resistant to abrasion, oils, grease, acids, and alkalis	Not moisture resistant	Good for most commercial installations	Economical
Vinyl sheeting	Waterproof, resistant to most chemicals	Requires fairly smooth floor surface	Moderate traffic areas	Moderate to expensive

Figure 7-26. Resilient Floor Coverings

tions. A conductive type is available in heavy gage for use in computer rooms, or in rooms containing explosive substances. Conductive linoleum dissipates static charges which build up as people move over it, reducing the possibility of static sparking.

- Rubber is a relatively expensive material of excellent resilience and resistance to indentation. It also has good resistance to grease, alkali, and abrasion. It is used in general applications, and for floor-runners and as stair-tread covering.
- Homogeneous vinyl has excellent resilience and resistance to abrasion, indentation, grease, and alkalis. As the proportion of vinyl-to-fillers increases, desirable properties decrease. Backed vinyl is second to homogeneous vinyl in quality; vinyl asbestos is third. Slip-resistant, heat-resistant, and conductive types are available.

Adhesives are of primary importance in the satisfactory performance of resilient flooring. There is a wide variety available. The most common adhesives are: paste, epoxy, cut-back asphalt, clay- and asphalt-based emulsion, and resin-based cement.

- Paste is a water-soluble, all-purpose adhesive for above-grade installation of felt-lined, backed-sheet materials such as linoleum, or rubber tile. Paste should not be used for asphalt or vinyl asbestos tile.
- Epoxy is a chemically set, waterproof, two-component adhesive with outstanding bonding characteristics. It can be used with any concrete or wood substrate, above, on, or below grade.
- Cut-back asphalt is an inexpensive moisture-resistant adhesive. It may be used over concrete, felt lining, and wood surfaces for asphalt and vinyl-asbestos tile. It should not be used over asphalt or latex leveling coats.
- Clay- and asphalt-based emulsion is a moisture-proof, all-purpose adhesive for asphalt and vinyl-asbestos tile. It can be used above, on, or below grade. It can be used over latex and asphalt type leveling coats.
- Resin-based cement, usually cumar or oleoresinous adhesive, is used on or above grade for cork, vinyl, or linoleum sheet or tile where surface moisture is expected.

Carpeting

Carpeting is available in a variety of yarn materials, construction types, colors, patterns, and textures. The construction of the carpet—pile height, pitch, and yarn count—determines its resistance to wear. Carpeting provides underfoot comfort, reduces impact noise, and resists the movement of sliding chairs or of rolling rubber wheels. As in the selection of any flooring, carpet selection must consider durability, comfort, and resistance to wear. Additional considerations in carpet selection: sound absorption qualities, to reduce noise levels within a space and to minimize impact noise between spaces; and thermal insulation provided by carpet between a space and the space below.

Carpet density, one of the best indicators of carpet performance, depends on four factors:

- Pitch, that is the number of warp lines in a 27 inch width; the higher the pitch the denser the carpet.
- The number of lengthwise yearn tufts, or stitches, in one inch of carpet; density increases as the number of tufts increases.
- Pile height, measured from the surface of the backing to the top of the pile; a medium pile height usually offers better service than a high or a low pile.
- Gage, that is the distance between two needle points in a fraction of an inch; the tighter the gage, the denser the carpet.

Other standards for carpets relate to tuft bind, resistance to delamination, resistance to piling and fuzzing, abrasion resistance, resistance to pile crushing, light fastness, static control, and flame retardancy. Carpeting must meet these criteria appropriately, depending on the intended use. Traffic-wear requires special attention, aided by the following categorization of wear-situations:

Class 1—Moderate traffic

Areas subject to moderate or regular use

Class 2—Heavy traffic

Areas subject to frequent traffic consistently following the same direction; heavy tracking of soil; fiber-twisting and -turning; and/or considerable spillage.

Class 3—Extra-heavy traffic

Areas subject to exceptionally high levels of frequent and concentrated traffic in the same direction; severe tracking of soil; severe fiber-twisting and -turning; heavy rolling traffic; and/or frequent spillage.

Carpet textures include several varieties. Level-loop pile has its loops at the same height. The texture is produced by tufting, knitting, or weaving. Variations of this surface include high and low loops. This carpet is suitable for heavy use areas but is difficult to clean. A cut-pile texture uses unset yarns—for an uneven velvety texture—or firm-ended yarns—more luxurious, but showing footsteps or flaws more easily. Cut- and loop-surfaces are produced by combining different loop heights. A variety of textures can be obtained by this method.

Static resistance can be achieved either by incorporating special fibers and metallic wires, or by the use of chemicals. Both methods dissipate static electricity generated by movement on the carpet—especially important for rooms housing any sort of sensitive electronic equipment.

High-strength carpet fibers are acrylic, nylon, olefin, polyester, and wool. These fibers have characteristics that can be matched to the intended use. (See Figure 7-27.)

- Acrylic fibers are light, with a wool-like appearance. They have fair durability, fair stain- and abrasion-resistance, and good crush-resistance. They are usually more expensive than nylon.
- Nylon is the strongest of all man-made fibers. It is economical, easy to clean, has excellent abrasion resistance, and good crush- and stain-resistance.
- Olefin or polypropylene is used in indoor/outdoor applications. This material has good resistance to fading and abrasion, but it has poor resiliency.
- Polyester feels like wool, has good abrasion-resistance, and fair crush-resistance. Polyester is less static-prone than other man-made fibers but is more susceptible to oil-based stains and soil.
- Wool is a heavy soft natural fiber. It has good serviceability and resiliency, but it is not as durable as most synthetics. It also is the most expensive of the carpet fibers.

Backing is the material that forms the underlying base of the carpet.

- The primary backing in a tufted carpet is the material to which the surface yarns are attached. It may be of jute or cotton, or of woven or non-woven synthetics.
- The secondary backing, also called double-backing, can be of any material laminated to the primary backing. It serves to improve resiliency and add dimensional stability to the carpet.

Separate padding or cushion material can be used under the carpeting. It can be of felted cattle-hair, jute, foam rubber, or plastic foam. Over concrete, it is usually glued; over wood, stapled. Padding extends the life and resiliency of carpeting.

The carpet's color can camouflage dirt, grit, and stains. Earthtones and grayed colors hide soil well. Multi-colors and heather are better than solids for hiding dirt. Light colors show tracking and dark colors show dust and lint; middle-value tones, therefore, are often a better selection. Dark carpet colors require high levels of lighting in the room because they absorb, rather than reflect light. Delustered carpets hide soil better than highly lustrous carpets.

Improper carpet installation can result in a shortened carpet life and physical hazards. In moderate traffic areas, carpet may be stretched over a pad or directly glued down. Carpet pad provides comfort, noise absorption, and longer life appearance. For heavier traffic, particularly where rolling traffic is present, carpet should be directly glued down to prevent delamination or wrinkling.

A carpet should be regularly maintained as recommended by the manufacturer. Frequently, carpet is replaced because it is dirty, rather than because it is worn out. Ignoring the manufacturer's maintenance recommendations may result in damaged color fastness, increased soiling, and mildew.

Other carpeting considerations:

- Broadloom carpet. Broadloom refers to carpets made on a loom, generally in widths of 6, 9, 12, and 15 feet. The type of installation and the size of the area to be covered can determine the width to use: for example, a six-foot width can be used in corridors, preventing excessive labor and waste. Seam-placement should be considered to avoid major traffic patterns. A disadvantage of broadloom carpet is the limiting of access to under-floor utilities.
- Carpet tile. A carpet tile is usually 18 or 24 inches square and may be fusion-bonded or tufted. The advantage of carpet tile is ease of replacement and less waste of installation. While the material cost of tile is higher

FIBER	APPEARANCE	RESILIENCE	ABRASION	SOIL RESISTANCE	CLEANABILITY	STAIN RESISTANCE	FUZZING/ PILLING	STATIC BUILD-UP
Acrylic	Warm; wool appearance	Fair	Fair to good	Good	Good	Good	Some when new	Good
Modacrylic	Soft, luxurious	Fair	Fair to good	Good	Good	Good	Not a factor	Good
Nylon	Dull to lustrous	Good	Very good to excellent	Very good	Good	Very good	Some with staple fibers	Poor
Olefin	Subdued luster, waxy feel	Poor	Good to very good	Very good	Very good	Very good	Not a factor	Very good
Polyester	Soft, luxurious, close to wool	Fair	Good to very good	Very good	Good	Good	Some when new	Good
Wool	Soft, warm, luxurious	Excellent	Very good to excellent	Very good	Good	Fair	Some when new	Fair

Figure 7-27. Comparative Characteristics of Carpet Fibers

than of broadloom, the installation cost is lower. Tile also allows immediate under-floor access for utilities. Tile adheres to the floor surface by its own weight and vacuum force. In extreme traffic situations, a perimeter row of tiles is adhered to the floor to prevent movement.

Partitions

Partition assemblies—or, more commonly, partitions—may divide space in various ways: sometimes providing only visual separation; sometimes providing contained spaces each with its own environment. Partitions may be transparent, translucent, or opaque. They may be of any height, and open or closed at floor level. Partitions can be grouped into four major types, based on their method of installation or use—portable, demountable, movable, and fixed.

- Portable partitions are prefabricated, prefinished panels that can be easily moved without the need of special equipment. These include self-supporting screen panels up to seven feet in height or full height panels supported by the floor or fastening to the ceiling is not required.
- Movable partitions are prefabricated prefinished assemblies that form a complete, continuous closure from floor to ceiling. These are supported in tracks in the floor or ceiling, providing for the movement of the panel. These partitions are used in large spaces when a high degree of flexibility is needed in dividing those spaces. An example: in a conference area that may be broken down from a large room into smaller units.
- Demountable partitions can be repeatedly disassembled without destroying the component parts, then reassembled in a different location. They may be completely prefabricated panels fixed to the floor or ceiling, or prefinished facing panels fixed to a permanent frame.
- Fixed partitions are site-constructed of various components. Usually, they cannot be relocated without destroying most or all of the component parts. Fixed partitions are fixed and bonded to the floor and when full height, braced by the finished ceiling or floor/ceiling assembly.

Partition Assemblies

Partitions must be stable. They must support themselves as well as the loads attached to them—such as shelves, cabinets, or other equipment. They must resist lateral impact and air pressure.

Normal air-pressure loading is assumed to be five pounds per square foot, but high-pressure conditions can exist around high-speed elevators, or pressurized rooms such as clean rooms. For lateral stability, cornice-high and rail-high partitions should be braced to the ceiling by posts, or by cross walls. Here, unsupported length is more critical than unsupported height. When no posts or cross walls are provided, a partition should be designed as a cantilever—anchored to the floor.

Partitions may allow or limit the passage of vision, light, and air. Each of these influences the degree of isolation that a partition provides. Of the three, the passage of air is the most difficult to control, especially in demountable and portable partitions. Control of air passage enables the control of sound, so this is a particularly important consideration.

Sound transmission through a partition is measured by its sound-transmission coefficient. This is the number of decibels a sound is diminished in passing through a partition. In general, it has become accepted that loud sounds will be heard through most partitions; privacy is served by making those sounds unintelligible. It is also important to note that partitions are not the only means of limiting sound transmission between spaces. Particularly for low office partitions, other considerations are necessary. More information on this subject may be found in the discussion of acoustics.

Walls and partitions may be required to resist the passage of smoke and fire. Applicable construction standards, based on the size and occupancy of the space to be enclosed, determine this requirement. Fire-resistance and smoke control are usually required of fixed partitions, but also may be required of movable and demountable partitions. As with the provisions for the control of sound, the control of smoke and fire is a part of an overall building scheme, not limited to considerations for partitions. The openings in partitions—for doors, windows, and utilities—present a particular problem. All openings in a fire-rated partition must be protected with fire-rated assemblies, such as fire shutters or doors. Duct penetrations through a fire-rated partition must be protected with fire dampers. Pipe penetrations must be firestopped. Further information on this topic may be found in the discussion of Fire Protection and Life Safety.

Partition Finishes

Surface-finish on interior-wall surfaces protects the underlying structural elements, and enhances the spaces enclosed. General criteria for an interior wall finish includes considerations of expected wear and abrasion on the wall, maintenance requirements, sound-transmission and -reflectance requirements, and the light-reflectance requirements.

Among the more common surface-finish materials are ceramic tile, vinyl wallcovering, fabric, plastic laminate, carpet, and paint (a special category).

- Ceramic tile is cold, hard, durable, and waterproof. It is available in a variety of sizes and finishes. It is suitable in high moisture areas; it is easily cleaned; it is highly resistant to wear and to fire.
- Vinyl wallcovering is more durable than ordinary washable wallpaper because of its vinyl content. It is resistant to grease and stains. Vinyl wallcoverings come in a wide variety of designs, colors, and finishes. There are three grades of vinyl wallcovering available on the commercial market. The light grade—seven ounces per linear yard—is recommended for areas where abrasion and wear is low. The medium grade, thirteen ounces per linear yard, is used for modern-wear areas. The heavy grade—twenty-two ounces per linear yard—is intended for areas where heavy traffic, wear, and abrasion are constant.
- Fabric provides a malleable, supple, and textured surface, useful in reducing sound reverberation. It is less expensive to install and remove than stone, marble, and choice wood. The disadvantage of fabric is a wallcovering is poor cleanability, and susceptibility to decomposition and sun-rot in direct sunlight. Raveling and fraying can occur at seams and edges in some fabrics.
- Plastic laminate comes in a variety of colors and finishes. It is tough and easy to clean, but is not heat resistant. Initially, cost is moderate to high, but the life of the material is long. The size of the material should be considered to minimize unsightly seams. Laminate can be easily cut with a fine-toothed saw, and glued directly onto plywood or particle board. Fire-safety requirements may restrict or limit the use of this material.
- Wall carpet is an excellent finish to control distracting ambient sounds in a high-density, high-activity area, such as a Crisis Action Team space. Also, areas that require extensive wall mounted graphics, such as Watch Team spaces, should be considered for wall carpeting backed by 3/4 inch plywood for attachment support. The carpet surface does not show damage as displays are changed, and the total wall plywood fastening capability allows for all shapes and sizes of displays to be utilized over time. Even though carpet has a high initial cost, it has a very competitive life-cycle-cost.
- Paint is composed of finely-ground solid pigments, suspended in either a water-based or an oil-based liquid solvent.

Water-based paint has synthetic resins and color pigments suspended in a coater. It is easier to use than oil-based paint because it cleans up with soap and water. Although it dries more quickly than oil-based paint, it is not as durable or waterproof and cannot be applied directly to a metal surface.

Oil-based paint is composed of natural and synthetic resins and color pigments, suspended in oil and white spirits. It is very durable and washable.

There are four common paint finishes:

1. Flat-matte paint has a high pigment content which increases coverage. It has a dull, non-reflective finish that is not washable.

2. Eggshell paint has increased reflectance over the flat-matte finish, and is more easily cleaned. It is suitable for areas that have medium-moisture levels.

3. Semi-gloss paint has more pigment content and less film former than high-gloss paint. The finish provides both a glossy appearance and reflective qualities. The enamel content makes this paint durable and washable. This is the best choice for most all command center functional spaces.

4. High-gloss paint is the most durable and washable. It has high reflectance and is resistant to marking. It is suitable for high-moisture areas.

Ceilings

The ceiling membrane is subject to a number of external factors which may affect its performance and the effects of which the membrane may have to resist. These include pressure differentials, sound penetration, heat flow, air/water vapor penetration, chemical and biological attack, deflection, expansion and contraction, suspended loads, and fire. All of these factors should be considered in the initial selection of the type of assembly and of the type of membrane.

Ceiling Membrane Types

The ceiling-membrane types are uninterrupted membrane, penetrated membrane, and integrated membrane. An uninterrupted membrane has no or few openings for electrical or mechanical services. A penetrated membrane is penetrated by limited service at random locations. An integrated membrane usually is suspended, laid out in a grid pattern with various service outlets located within the grid.

In selecting a ceiling assembly, consider not only the performance requirements of the ceiling membrane itself but also the limitations imposed by other components of the structure or by the installation methods.

Most existing command center functional spaces have suspended-membrane ceilings. Suspended-membrane ceilings, especially the integrated type, are subject to pressure differentials which may lift or rattle the lay-in panels. They are subject to air leakage and water-vapor migration through the joints in the membrane and around the mechanical and electrical service components, and to heat flow into a cold plenum. Installing thermal insulation over the membrane can minimize this problem but can create others, such as condensation within the insulation, or heat build-up under lighting fixtures—shortening lamp and ballast service-life. Suspended membranes may be subject to lateral loading by attached partitions. The suspension system should be of adequate strength to resist these loads. In addition, sound transmission from one space to another may not be effectively controlled when soft, sound-absorbent lay-in panels are used in a suspended grid ceiling.

Suspended membranes are least affected by deflection and expansion or contraction in the supporting construction. Suspended-grid membranes do not normally require provisions for controlling expansion in large areas, for their relatively small component parts can accommodate expansion without much effect to the entire assembly. Expansion in a large monolithic membrane such as plaster, or in large panel membranes such as gypsumboard, is cumulative. To overcome this difficulty, allow free movement along the perimeter, and incorporate expansion joints into the membrane itself. In evaluating specific types of suspended-membranes, consider the following:

- Select metal-pan tiles, or metal or plaster panels when resistance to impact, ease of maintenance, and utility accessibility are required. These have a high initial cost but will pay off in the long run for command center spaces that have ceiling mounted signal and power cabling that requires periodic accessibility.
- Though acoustic tile has many advantages it also has disadvantages. It is difficult to clean and cannot be repeatedly repainted without the loss of its sound absorbing properties. Where acoustic tile is subject to soiling, dust accumulation, or airborne moisture, use a plastic-film-faced tile, even though it costs more. Acoustic tile ordinarily is not resistant to impact, although special-impact and dislocation-resistant types are available. Acoustic tile ordinarily is not resistant to high humidity or steam, although special types are available for use under high-humidity conditions—such as suspension systems of noncorroding metal.
- Installing an exposed grid type ceiling over several ceiling-high partitions must achieve proper closure between the top of the partition and the membrane. In small spaces, exposed grid may limit choices in locating lighting fixtures and/or diffusers. It's very difficult to attach any angle or channel directly to framed, gypsum-wallboard-faced partitions. Few partitions are straight enough to keep an angle or channel in even contact.
- Before selecting a concealed-grid suspended ceiling, consider that changes or repairs will be difficult to make, and usually will be noticeable after completion.
- Before selecting plaster or gypsumboard ceilings, consider that openings in plaster usually require plaster frames or screens, adding cost to the membrane. Further, stresses may build up at larger openings, especially when closely spaced; cracking of the membrane may result.

ACOUSTICAL QUALITY

The proper acoustic design avoids the poor sound quality that would interfere with a facility's mission. A poorly designed acoustic environment interferes with every activity it is meant to accommodate; a well-designed acoustic environment unobtrusively facilities these activities. This is especially significant in command center spaces where concentration is required, or where "high-impact" decisions are made.

Hearing involves three elements: the source of sound; the path of the sound; and the receiver of the sound. Effective control of acoustics must deal with each of these.

- The source of sound may be made more or less intense.
- The path of the sound may be made more or less effective.

- The listener may be made more or less attentive.
- For command centers, two specific requirements must be met:
  - The transmission of sound between rooms must be limited.
  - A speaker in a briefing, command meeting, or training session must be clearly heard.

Sound Transmission

Sound is transmitted along two paths: through the air, and through structure.

Airborne sound may move through partitions or floor/ceiling assemblies, or it may pass around the through openings.

Structure-borne sound is transmitted by these assemblies by the building structure. The source of such transmission may be vibrations from mechanical equipment, or impact noise from operational activity. The table summarizes noise sources and means to control them.

For air-borne sound transmission, security-requirements specify the sound transmission class (STC) that governs wall assemblies, based on the activity that the wall encloses. The STC rating is defined as the number of decibels a sound is reduced in passing through a wall or partition. It is not an absolute value, and can be taken only as a rough guide. Wall types, with STC-ratings and sound-characteristics, follow:

- Type 1 (STC of 30 or less): Loud speech can be heard and understood enough to be obtrusive. Normal speech can be heard but not easily understood.
- Type 2 (STC of 30 to 40): Loud speech can be heard, but is barely intelligible. Normal speech can hardly be heard.
- Type 3 (STC 40 to 45): Loud speech can be heard faintly, but not understood. Normal speech cannot be heard.
- Type 4 (STC of 50 or more): Very loud sound, such as that produced by a sound-amplification system at high volume, can be heard faintly or not at all.

Based on these wall types, recommendations for various command center building areas and functions are shown in Figure 7-28.

	Recommended Wall Type
Offices	
Command Office	3
Private offices	2
Open workspace	3
Watches	3
Conference rooms	
Briefing or conference rooms	3
Training-plans rooms	3
Conference rooms with movable partition	3
Auditoriums	
Auditorium with sound reinforcement	4
Auditorium without sound reinforcement	3
Projection rooms	3

Figure 7-28. Command Center Wall Type Recommendations

Structure-borne sound transmitted through floor/ceiling assemblies is of particular concern. The impact noise rating (INR) and impact isolation class (IIC) are measures of this noise.

- The INR is a measure of variance in decibels from a standard sound-transmission curve. The INR indicates how far below or above the standard curve the test curve falls. Negative INR values are acceptable only in non-critical spaces. For spaces housing critical activities, INR values should exceed 10.
- The ICC is a single number-rating system devised by the Federal Housing Administration for rating impact sound isolation. The IIC results in a positive rating which more closely parallels the STC rating system for airborne sound transmission. The IIC is derived in the same manner as the INR.

On the above, an IIC rating for a given construction is approximately 51 dB higher than the INR rating. For example, an INR rating of +4 would be

comparable to an IIC rating of approximately 55. However, exact values for IIC ratings should be determined on the basis of individual test data.

Carpet and pad combinations are effective in improving the impact sound isolation performance of any type of floor system. Improvement depends on carpet thickness, degree of pile matting and weight of carpet and pad. However, no appreciable gain in airborne-sound isolation is obtained using carpet and combinations.

Sound transmission may be further controlled through control of ambient noise. Ambient noise is the continuous background noise present in any room from air conditioning, lights, or other continuously operated equipment. There are at least three important reasons for attention to ambient noise levels.

- Excessive ambient noise may drown out faint sounds originating within a room.
- Excessive ambient noise may in itself be annoying: the continuous ambient noise may be so loud as to be annoying to personnel whether they are engaged in critical activities or not. This is a particular problem in command center ADP-equipment rooms, where noise from equipment is high.
- Conversely, low levels of ambient noise may not mask or cover up intruding sounds from surrounding activities.

Sound can be heard if it exceeds a room's background noise level. The more that noise levels are reduced, the easier it is to hear intruding noise. For quiet areas, such as administrative or other office areas, ambient noise levels may not be adequate to mask noise transmitted into the room. Sometimes "white noise" is added to remedy this situation. White noise is an artificial background noise, produced for its masking qualities. White noise can be a problem, however, if it is not used consistently throughout a facility. Absence of this sound in one room calls attention to it in other rooms—often very disturbing to building occupants, inhibiting performance. While this is still experimental, individual white-noise generators can be placed and controlled at individual work stations.

Hearing Conditions

The design of rooms to facilitate hearing is a specialty in itself. There are, however, certain basic requirements that must be met for any room: quiet background, sufficient loudness of the sound source, proper sound distribution, and adequate blending and separation of sounds.

Assuring sufficient loudness in a briefing room—where everyone in the room must be heard—is more difficult than assuring loudness from a single-sound source. Voice levels vary widely as do sound levels from recordings and other transmissions. It often is advisable, therefore, to provide a sound-enhancement system. There is a distinction between sound amplification and sound enhancement:

- Sound amplification increases the sound level uniformly throughout a room. When persons speaking from various locations in the room are the sound source, amplification may not be appropriate.
- Sound enhancement increases the sound level only in areas remote from the sound source. For example, a microphone at one end of a long table projects sound only to listeners at the other end of the table, not to listeners nearby. In most small- to medium-sized applications, sound enhancement is much to be preferred over sound amplification, for it can be used subtly, without the intruding sense that a sound system is being used. Indeed, with such a system it is often desirable to conceal both microphones and sound-speakers, to preserve this subtlety.

Proper Sound Distribution

Sufficient loudness in small-and medium-sized conference rooms usually is not a problem. In any room, however, it is possible for sound to be blocked, resulting in an uneven distribution of sound. If a listener's sight-line is clear to the source of a sound, the sound will have a clear path as well. Concave walls or ceilings present a problem, however, for they focus sound resulting in an uneven distribution.

Blending and separation of sound is a product of the sound-reverberation in a room. Reverberation is a function of sound absorption. Reverberation in a room is measured by reverberation time—the time in seconds required for a sound to diminish 60 decibels after the source is stopped. A room with reverberation time that is too short has a "dead" sound: sounds are flat, of brief duration, and difficult to hear. A room with a reverberation time that is too long has a "hollow" or "cavernous" sound: sound is drawn out, obscuring successive sounds; speech is difficult to understand.

For listening to human speech in a small- to medium-sized room, the reverberation time of the room should be between 0.6 and 1.6 seconds.

Figure 7-29 is a summary of how common acoustical problems can be controlled. Many of the reco.nmendations can be accomplished by "self-help" or local efforts, others require more significant "outside" corrective measures if the problem seriously impacts the mission functions of the space. Interior construction must provide acoustic control in response to operational requirements. It must provide control that will:

- Limit transmission of air-borne sound between operational areas, within security criteria
- Limit transmission of structure-borne sound
- Limit transmission of sound through partition openings and connections
- Provide proper sound levels and reverberation time to ensure clear hearing.

LIGHTING SYSTEM

Lighting has a significant effect on the working environment. Also, lighting should be designed for aesthetics, brightness-control, specular reflection, operating cost, and energy conservation. As with other technical requirements, provision of good lighting requires consultation with experts. The most important aspects of lighting design are quality and quantity of light. Other influences on lighting design are finishes, colors, textures, layout of furnishings, ceiling heights. Secondary areas may utilize spilled lighting from the primary area. When providing general spatial illumination, economic and functional criteria must be taken into account. Analyze the lighting needed for each task or area within a space. Functional and aesthetic criteria often vary with a space; consequently, a variety of lighting configurations may be required.

SOUND PATH	SOUND SOURCE	EXAMPLES OF SOUND PROBLEMS	CONTROL OPTIONS
Airborne - trar.emitted	Voice	• Conversations • Presentation briefings • with sound systems • Recorded material	• Design walls to approved STC. • Increase sound absorption within the source room to limit the level of sound which may be transmitted • *Use sound enhancement systems rather than amplification for conference areas.* • Do not install back to back fixtures or devices in partitions • Install phones with quiet ringers • Isolate printers in sound proof enclosures • Install type A lighting ballasts, properly mounted or isolated (Ballast noise may be particularly problematic when parabolic louvers are installed in fluorescent fixtures)
	Equipment	• Phones ringing • Typewriters/printers • Lighting ballast noise • Office computers	
Airborne - flanking	Voice	• Conversations • Presentation briefings with sound systems • Recorded material	• Seal the edges of partitions. • Isolate noisy activities from quiet • Extend partitioning through suspended ceilings to the underside of the floor/ceiling assembly or suspend sound absorbent baffles in the ceiling cavity
	Equipment	• Phones ringing • Typewriters/printers • Lighting ballast noise • Office computers	
Structure-borne	Mechanical	• Pumps • Compressors • Fans • HVAC controls	• Heavy equipment should be mounted on its own structural pad isolated from the building structure to prevent vibration noise from being transmitted to the building • Equipment should be isolated from the building by resilient mounts • Mechanical rooms should be located away from quiet areas
	Impact	• Footfalls • Dropped objects	• Install carpet and pad • Suspend ceilings with resilient hangers

Figure 7-29. Sound Control Options

Interior Lighting

Interior lighting for optimum user comfort and efficiency requires suitable lighting-fixtures and illumination-levels for equipment and operational spaces. Interior lighting includes consideration of:

- Efficiency, alertness, and visual comfort
- General lighting-design factors
- ESI/VCP lighting-design factors
- Lighting control through dimming
- Special lighting requirements for visual display terminals
- Other special lighting requirements.

Efficiency, Alertness, and Visual Comfort

Efficiency and alertness depend to a large extent on visual comfort—the performance of assigned tasks without eye strain. Comfort for human eyesight depends on adequate illumination levels, absence of glare, and appropriate contrast levels. Traditional illumination levels may be higher than needed for comfort or effective task performance. Uniform lighting, maintained at a level necessary for certain critical tasks,sometimes over-lights other tasks. When this happens, task lighting should be considered.

Contrast is vital in visual communication, but excessive background brightness can disrupt the eye's ability to perceive fine detail. In the extreme, glare or reflections from background brightness can temporarily cripple vision by destroying the observer's ability to adequately perceive a task, obstruction, object, or space. Increasing illumination to increase background brightness can defeat its purpose.

There are three types of reflection: specular,spread, and diffuse.

- Specular reflection

Specular reflection is the reflection from a mirror or other highly polished surface. In specular reflection, the angle of incidence equals the angle of reflection.

If the source of light is comparatively small, specular reflectors redirect light in precise beam patterns. Therefore, very accurate reflected light patterns require that the light source be as small and as compact as possible.

Three specular-reflector shapes are commonly used in lighting equipment. Each can be formed by passing a plane through a conic section.

1. A parabolic reflector is among the most useful. When a point light-source is placed at the focus of a parabolic reflector, all light rays reflected are parallel. All command center spaces that have either large screen displays, monitors and/or terminals should use parabolic reflectors on any ceiling "down-light" fixtures. This will minimize any reflections on the display surfaces from the fixtures themselves.

2. An elliptical reflector (sometimes called an ellipsoidal reflector) has two focal points. When the light-source is placed at one focus, the rays leaving the reflector converge at the second focus. This second focal point is called the "conjugate focal point." The image of the light-source is reversed after it has passed through the conjugate focal point. This characteristic crossing of the rays at a second point in front of the reflector makes is possible to direct a relatively large spread of light through a very small opening.

3. The circular reflector has the simplest of all the reflector shapes. When a point source of light is placed at the center of the circle, the reflected rays pass back directly through the source, increasing the apparent intensity of the source.

- Spread reflection

Spread reflection is a second degree of reflection. The spread reflector has numerous small surfaces that lie only on an average plane. For this reason, most light rays from a light-source follow the direction indicated by the reflector, even though the direction is slightly out of line. The result is to maintain the general direction, but to "spread" the light a little.

- Diffuse reflection

Diffuse reflection occurs where the reflecting surface redirects incident light in all directions. This eliminates any directionality to the reflected light, and tends to offset the effect of a reflector shape. Flat white paint and unfinished white plaster are good diffuse surfaces. Diffusing materials appear nearly equal in brightness from all angles of view.

The surfaces of specular reflectors are often roughened to provide some diffusion. This hides beam irregularities caused by filament striations or other light-source imperfections.

The standard usually used to determine the acceptability of a lighting installation is a measure of the light falling on an environment—expressed in footcandles. However, the eye does not react to incident light; it responds to reflected light—expressed in footlamberts. Footcandles—measuring incident light—are simple calculable quantities indirectly used in developing light levels for seeing. Reflected light, however, has been modified by the effects of object size, simultaneous contrast, viewing time, and color.

Extreme contrasts between high and low areas of brightness can strain the eyes, particularly if the viewer is subjected to these conditions for long periods of time or is engaged in detailed tasks. On the other hand, some contrast is essential if seeing is to be comfortable and effective. The problem is to control reflected light for optimum effect.

Brightness can be divided into two categories.

- Subjective brightness is the conscious light sensation resulting in the feeling of intensity. Here, a range of words describes the effect: dark and light, dim and bright, etc.
- Photometric brightness refers to a measured amount of brightness. Photometric brightness is also called luminance.

General Lighting-Design Factors

The following are the basic factors to be taken into account in the design of lighting systems:

- General requirements
  - Purpose of the interior (may be diverse, with more than one lighting-scheme needed); probable layout of plant furniture or equipment, where this is known.
  - Availability of daylight: the need to combine electric light and daylight.
  - Extent to which contrast rendering in the task is important: risk of veiling reflections.
  - Degree of modeling required and provision of directional lighting.
  - Color appearance and color rendering required.
  - Task and building illuminances; localized or general lighting; need for optical aids.
  - Requirements for glare control.
  - Statutory requirements or official recommendations.
  - Need for emergency lighting.
- Location requirements
  - Dimensions of interior: length, width, height.
  - Luminaire mounting height.
  - Luminaire spacing/mounting height ratio.
  - Reflectances of ceiling, walls and floor, including influence of furnishings, windows and glazed partitions.
  - Coordination of lighting equipment with other building services.
  - Limitations on luminaire mounting position (e.g., roof structure, number of bays, modular construction of building, space available in ceiling void).
  - Effects of obstructions by parts of structure (e.g., beams) and other services (e.g., ventilation ducting, pipework).
- Lamps selection
  - Lamp types that meet color appearance and color rendering requirements for interior activity.
  - Lamp light-output related to source-size and mounting height.
  - Rationalization of lamp-type, -color and -wattage, particularly with existing installations.
  - Heating-up time to full light-output.
  - Need to reduce flicker and stroboscopic effect.
  - Capital and operations cost.
- Luminaire selection
  - Suitability for purpose

- Aesthetic appearance.
- Intensity distribution required.
- Authenticated photometric data.
- Need for special equipment.
- Availability of spare parts.
- Weight; arrangements to hold the luminaire in place.
- Use of supporting systems or lighting tracks.

- Maintenance requirements
  - Accessibility; need for special equipment.
  - Lights selected should provide easy access for relamping and maintenance. Special attention should be given to lighting for high-bay areas so that these lights can be relamped when necessary.

Electric-lighting sources include fluorescent, metal halide (MH), and high-pressure sodium (HPS). Daylighting sources include lighting conduits (fiber optics and light pipes), light shafts, periscopes, solar connectors (heliostats and compound parabolic connectors), and standard architectural fenestrations (windows, skylights, clerestories). Mercury-vapor and incandescent light sources have been eliminated because of their relatively low efficacies. Low pressure sodium (LPS) has been eliminated because of its monochromatic color-rendering properties. Daylighting can be used in conjunction with one of the electric-lighting sources.

- Electric lighting sources

In recent years, fluorescent lamps have been redesigned and new phosphors added, resulting in a 15 percent reduction in wattage while retaining nearly the same lumen output. This redesign coupled with the installation of energy-saving ballasts has increased the efficiency of standard 4-foot lamps to 89 lumens per watt. This efficiency will be increased even more with greater use of solid-state, high-frequency (3 to 10 kilohertz) ballasts now being developed and tested. Early indications show a 20 percent decrease in energy usage for the same lumen output. Further, these solid-state ballasts can be either switched or dimmed.

Metal halide and high-pressure sodium (MH and HPS), the two more efficient high-intensity discharge (HID) sources, have also been redesigned. "Super" versions of the lamps have shown marked increases in lumen output. MH and HPS are now available with efficacies of 90 lumens per watt and 100 lumens per watt, respectively. Even the restrike time inherent with HID has been eliminated in some new lamps. In the future, control of the fluorescent and HID sources seems likely to become more sophisticated.

The microprocessor may allow for complete control of the lighting systems. This control may be local, remote, both local and remote, time-activated; photocell-activated or any combination of these modes.

- Daylighting

Command centers with their hardened, shielded exteriors make standard fenestration unrealistic. However, other methods are available to bring daylight inside buildings. Several of these methods—fiber optics, light pipes (large cross section acrylic plastic), light shafts, periscopes, and solar tracking – can be combined to provide a method for introducing daylight inside the facility.

Light conduits, which include fiber optics and light pipes, are hampered by high light-transmission losses. These materials have transmission losses as indicated in the chart in Figure 7-30.

	Loss	Size
Glass fiber optic-normal	50%	1 inch
Glass fiber optic-medium	4%	1 inch
Glass fiber optic-low	1%	1 inch
Plastic fiber optics	80%	1 inch
Plastic acrylic (light pipes)	70%	any size or shape

Figure 7-30. Light Transmission Losses

Fiber optics and light pipes can be curved and bent to almost any shape, within the restraints of minimum radii for each material. High transmission losses for the plastic light conduits may eliminate them from consideration.

Light conduits require the focusing of sunlight on their ends. Acceptance angles are typically small for low-loss transmission conduits. Methods for collecting sunlight include tracking reflectors (heliostats) and concentrating reflectors (compound parabolic concentrators [CPC]). These collectors typ

cally must be located above ground and in full view. They must be close to the light conduits. This may prove to be a problem, depending on the need for keeping the command center out of sight.

Another method for bringing daylight inside these hardened buildings—while still providing some protection against nuclear blasts—is to use a series of mirrors in a periscope. Thick, clear plastics coupled with mirrors can provide a large area of light to the facility interior. This method should include a ferrous-metal grid to maintain EMI integrity, but this grid will greatly reduce the system's efficiency.

Light also may be introduced inside the facility by light shafts. These are large cross-sectional openings constructed of highly reflectant materials, used in conjunction with a heliostat or CPC. Use of this method would depend on the location of the facility and on the requirements for hardening or EMF shielding.

New developments in these areas are improving the efficiency of these methods.

Different illumination-sources have different advantages and disadvantages. These are reviewed for five electric-lighting sources. (See Figure 7-31.)

- Fluorescent
  - Large number of color types for selective color rendition
  - Ballast required
  - Low initial cost
  - Long life
  - Optical control possible with special reflector or lens
  - Low luminance with bare lamps
  - Special ballast and lamp protection required in cold ambients
  - Possible ballasts noise
  - Careful installation to assure correct ballast operation
  - Dimming of small numbers expensive and troublesome
  - Complete dimming system effective and energy saving;
- High pressure sodium vapor
  - Very high efficacy
  - Medium life
  - High initial cost
  - Pronounced orange color
  - 1 to 4 minute start- and re-start time
  - Good optical control possible
- Incandescent
  - Good color rendition except for blues
  - Inside frosted lamp good for optical control
  - Greatest variety of lamp shades and bases
  - Lowest initial cost
  - Easily dimmed
  - Life expectancy greatly affected by slight increase in operating voltage above rated voltage
  - Short life and low efficacy results; high owning costs
  - Radiant-heat noticeable above 85 footcandles
- Metal halide
  - Medium life
  - Good color rendition with some types, but some color inconsistency
  - Good optical control possible
  - Ballast required
  - Often noisy
  - Good efficacy
  - Start and restart delays up to 10 minutes
  - High initial cost
  - Poor lumen maintenance
- Tungsten halogen

LAMP TYPE	COLORS INTENSIFIED	COLORS SUPPRESSED	EFFECTS ON INSTALLATION	VARIOUS USES
Incandescent	Red, orange	Blue	Good color rendering	Dining rooms, homes, general offices
Fluorescent				
Cool White (CW)	Orange, yellow, blue	Red	Blends with natural daylight, good color acceptance	Offices, laboratories, classrooms, workshops
Deluxe Cool White (CWX)	All nearly equal	None appreciably	Best overall color renditions, simulates natural daylight	Private offices, conference rooms, retail areas
Warm White (WW)	Orange, yellow	Red, green, blue	Poor color rendering	General offices, utility areas classrooms
Deluxe Warm White (WWX)	Red, orange, yellow, green	Blue	Good color rendition, similar to incandescent	Dining rooms, homes, general offices
Daylight (D)	Green, blue	Red, orange	Adds bluish appearance	Production areas
White (W)	Orange, yellow	Blue, green	Shallow and wary effect	Laboratories, general offices classrooms
Soft White/ Natural	Red, orange	Blue, green	Adds warmth	Auditoriums, cafeterias, general offices
High Intensity Discharge				
Mercury Vapor	Blue, green	Red, orange	Distorts colors, can be color corrected	Classrooms, laboratories, work shops
Metal Halide	Yellow, green	Red	Warmer light than mercury vapor	Retail areas, utility areas kitchens
High Pressure Sodium	Yellow, orange	Blue, red	Very yellow appearance	Utility areas

Figure 7-31. Color Renditions and Recommended Uses of Artificial Light Sources

- Good color rendition
- Excellent for optical control
- Luminaires very small
- Easily dimmed
- High initial cost
- Short life
- Difficult maintenance and low efficacy results in high owning costs
- Very little interchangeability of types
- Radiant heating is noticeable above 85 footcandles.

VCP/ESI Lighting Design Factors

- Glare and Visual Comfort Probability (VCP)

Glare can be either direct or indirect. Direct glare comes mainly from two sources.

The first is an excessively bright luminous source shining into a person's eyes so as to reduce the ability to see the task. This is also known as a "disability glare." Looking straight at the high beam of an oncoming car is an example of disability glare.

The second is due to peripheral stray light that is not necessarily aimed specifically at the eye. This is known as "discomfort glare."

Indirect glare comes from the mirror-effect of the tasks that reflect the light source to the viewer's eyes, resulting in a visibility loss.

Glare can be corrected by: (1) reducing the source luminance, (2) relocating the source outside the normal visual field, (3) reducing the reflectance of excessively bright surfaces and (4) polarizing light from the source so that the light oscillates in the vertical direction only.

Direct glare is measured in terms of Visual Comfort Probability (VCP). Indirect glare is measured in terms of Equivalent Sphere Illumination (ESI). To provide good-quality lighting design, the VCP and ESI values of a lighting system should be as high as possible. Increasing one, however, tends to decrease the other. In a good lighting design they must be balanced, creating a design that will be most suitable for the purpose.

VCP values for direct glare can be obtained either by hand-calculation or by computer-programming. Hand calculations are tedious and time-consuming. If a request is made, manufacturers usually will supply a table of the VCP values of their luminaires along with the photometric report.

Several limitations prevent a predetermined VCP value from being totally accurate. Although standard conditions are selected to match most indoor lighting conditions, these are effective only for making a preliminary estimate. The installation's layout, luminaire mounting-height, illuminance level, and room-dimensions may not match standard conditions; hence, the "nearest" value received from a VCP table may be far from precise. The VCP evaluation method applies only to spaces with uniformly distributed luminaires; its values are not suitable for nonuniform layout or for uniformly distributed indirect lighting.

Luminaires with high VCP often have low efficiency. Highly efficient luminaires offer more light-per-watt, with a substantial amount of light directed at an angle that produces direct-glare. The usual way to increase the VCP of such luminaires is with special nonglaring louvers or modified lenses that form physical barriers; this, however, reduces efficiency substantially.

Dimming may be considered as a solution to this problem. Continuous dimming will gradually decrease the glare all around, and increase VCP, with insigificant change in the luminaire's efficiency. For fluorescents and mercury vapor, the percentage of light-output is almost directly porportional to the input-power.

VCP ratings should be compared only if applicable areas and situations are identical and if luminaires under consideration are the only variables. It should be remembered that standard VCP-data are calculated with a preset group of parameters, including the observer's looking straight ahead and sitting at the center of the rear of the room. Visual comfort is just one of the desirable factors in lighting systems, and should be kept in proper perspective with other objectives, such as energy conservation, costs, and productivity.

- Equivalent Sphere Illumination (ESI)

Indirect or reflected glare mainly results from light reflecting off a shiny or glossy surface into the eyes. The patches of light visible on the surface are light-source images. The glossier or more specular the surface of reflection, the more distinct the image of the source, and the greater the glare. Depending on

the angle and direction of the light rays, the reflected glare can be distracting and annoying, and can become the main reason for visibility loss.

Rays of light can be categorized, depending on angles and directions of arrival at the task. (See Figure 7-32 for an illustration of light ray patterns.) A ray arriving from an angle and direction that hinders visibility is a "poor ray." The shows the categorization of light rays with respect to direction of arrival, and the subsequent figure shows grading with respect to angles of arrival. The angle and direction at which the viewer sees the task are known as the viewing angle and viewing direction. Note that as the rays move back, visibility improves. The worst visibility occurs when the rays reflect off the task, directly to the viewer's eyes. The combination of all such poor rays "veils" the task, and this effect is known as a "veiling reflection."

Veiling reflection reduces the contrast of the task, reducing visibility and visual performance. This basically means that room lighting may actually hinder visibility, rather than improve it. Loss in contrast, or veiling reflection, is measured in terms of ESI.

In relating the concept of ESI to real environments, a hypothetical example can be used. The figure shows a real, everyday lighting environment in which light-rays, either directly from luminaires or bounding from room surfaces, strike the task at various angles and directions. Under these conditions, typical tasks, such as a book or a letter with black print on white pages, may not be satisfactorily visible, although a light meter near the task may read as high as 100 footcandles. The task is now placed inside a photometric sphere that provides the same visibility of the same task at the same viewing angle as was encountered in the room. A light-meter reading the illuminance level inside the sphere now may read a considerably smaller footcandle value—say, 50 footcandles. The ESI of the task in the room now can be claimed to have 50 ESI footcandles—the equivalent of 100 footcandles in the room.

Although ESI values are important for good lighting judgment, they should be used only when quality of visibility is important. For other noncritical areas, ESI is not as useful. ESI is a good tool for analyzing a lighting system or for comparing different luminaires for the same visibility; however, it should not be used as the only criterion for the final decision. It is one of many criteria to be considered in lighting design.

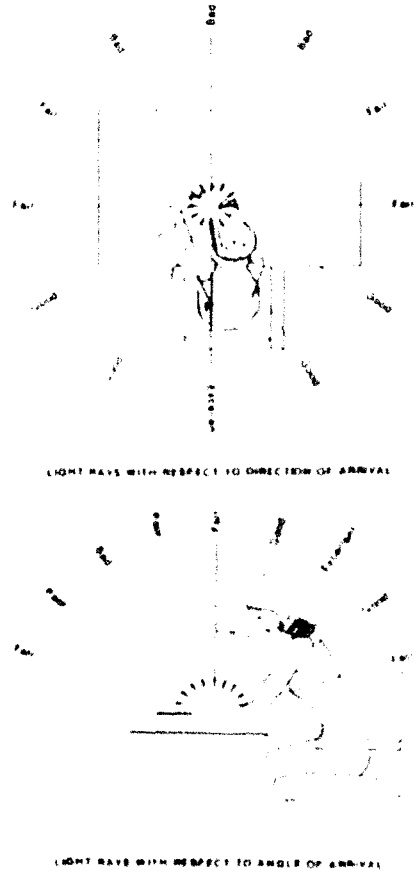


Figure 7-32 Quality of Light Rays Direction and Angle

Lighting Control Through Dimming

Variation of lighting intensity over a continuous range can be produced by dimming. The so-called "dimming curve" is a graph depicting the way that light-output responds to changes in the control-setting. If a change in the setting of the dimming control approximately equals a change in the amount of electricity reaching the light source, the dimmer is said to have a linear curve. However, the eye is more sensitive to changes at low light-levels than to changes at high levels. Even if a dimmer has a linear curve, a light source will appear to dim faster at low levels and slower at high light-levels. To correct this, dimmers may feature a dimming curve. Here the dimmer control moves at a constant speed, but the light dims faster at high levels and slower at low levels. To the eye, the effect is a constant dimming speed. Both logarithmic and linear dimming curves are supplied by equipment manufacturers.

Dimming methods are governed by the way in which electric power produces light. Separate methods are available for incandescent, fluorescent, and high-intensity-discharge dimming.

Incandescent Dimming

Incandescent dimming has the longest history. Three methods are commonly in use:

- Resistance dimming
- Autotransformer dimming
- Solid-state dimming.

The first dimming method used for incandescent light was the resistance method. It consists of a long resistance-wire made of metal that resists the flow of electrons over its entire length. This is connected to the power-source Connected to the incandescent is a second wire, attached to a "shoe"or "wiper" that slides along the resistance wire.

An advance in incandescent dimming was achieved with the development of variable transformers. A simple transformer consists of two separate coils of wire mounted so that the coils have overlapping magnetic fields. Therefore, the magnetic field created in the "primary" coil by the alternating current induces another magnetic field through a "secondary" coil. The alternating voltage in the first coil induces an alternating voltage in the second coil. If electric power is drawn from different points on the secondary coil, different voltages can be drawn from the transformer. The action of the basic autotransformer is similar to selecting different voltage outputs from a simple transformer—although certain modifications in the circuitry make the continuously-variable autotransformer operate more effectively.

Most solid-state dimming is based on the use of "thyristors"—power-control devices such as triacs, silicon-controlled rectifiers (SCR), and silicon-controlled switches (SCS). These solid-state devices allow electric current to flow at full voltage, but only for part of the time. The timing of the solid-state device is controlled by a low-voltage source that can be remotely varied. A small variable current, therefore, causes a larger one to change. The lamp dims as if the larger voltage were reduced (as with the autotransformer).

Fluorescent Dimming

Fluorescent light sources can be successfully dimmed through the control of electric power. Two methods are commonly used:

- Auto transformer dimming
- Solid-state dimming

The autotransformer was the first system employed for fluorescent service. It now is used primarily for small installations. It has been largely displaced by the solid-state dimmer.

In a simple installation, a solid-state dimmer is comparatively uncomplicated. When large numbers of fluorescent lamps are dimmed, however, the system must be more sophisticated. All components of the system should be supplied by one manufacturer so that they will be coordinated. The following should be considered in installing solid-state dimmers.

Only rapid-start fluorescent lamps can be used. During the dimming cycle, the electrodes of these lamps must remain heated. Instant-start and preheat lamp-electrodes are turned off after the lamps are started.

A dimming ballast must be used, and it must be compatible with the dimmer. Dimmer and ballast manufacturers will help in the selection of appropriate components.

A fluorescent lamp does not dim all the way off. If it is allowed to dim too far, the lamp will flicker, or a luminous spiraling form will be seen in the bulb Most fluorescent dimmers have an adjustment that prevents the user from dimming the lamp beyond a maximum down-position. When the maximum

down-position has been reached, the lamp will still be faintly illuminated. A switch must be used to turn it off completely.

The use of a starting aid is essential. The starting aid can be a 1" wide metal strip placed within approximately 1" of the lamp bulb; it must extend along the entire length of the bulb. A fluorescent housing can serve as a starting aid. In all cases, the ballast case must be electrically connected to the starting aid.

Only 3- and 4-foot lamps can be dimmed by most dimmers. All lamps controlled by a single dimmer should be of the same length, to dim at the same rate.

Fluorescent lamps used in dimming should be new, and it is wise practice to install them all at the same time. As some lamps grow old and begin to flicker, the complete set can be moved to an installation that is not dimmer.

High-Intensity-Discharge Dimming (HID)

Until recently, it was not possible to dim HID sources by controlling the electric power. When dimming was absolutely necessary, mechanical methods were used. Mechanical systems consisted of filters, shutters, or louvers that moved in front of the source, selectively blocking its light output.

Solid-state HID dimming has recently been introduced, limited to certain mercury vapor lamps.

Special Lighting Requirements for Visual Display Terminals

This information comes from recent research and from a search of available recent sources—by retrieval from various databases, and from university- and vendor-sources.

Responding to a survey question, "What makes a comfortable office?", office workers answered "good lighting" 85 percent of the time, and "a comfortable chair" 73 percent of the time. Recent studies of human vision have related peak human efficiency to responses to the illumination of tasks performed—specifically to certain characteristics of the illumination used. These tested human efficiency at various spectral levels of lighting. Lamps now have been developed with spectral distribution strong at high efficiency levels. In recent research, human response using these lamps indicates that color- and visual-clarity are improved. Concurrent tests also were performed using high-pressure sodium lamplight. It was found that not only was the color-rendering performance was worse, and visual clarity was impaired.

Lighting systems can be installed to elicit a maximum efficiency response. A work environment should be illuminated with non-monochromatic light, preferably with light, in the range of peak cone response, with brightness controlled, task contrast improved, and ceiling reflections and glare minimized. When installing a desk top computer (with a VDT), there are additional problems that may arise in viewing the VDT screen. The most common problem in lighting a VDT work station is glare, or images of ceiling or desk light-fixtures appearing in the screen. Another problem is eye-fatigue, from contrast differences when shifting from the source document—typically typed paper—to the VDT screen.

A nylon-mesh screen can be installed in front of the VDT screen for the prevention of screen glare and reflected images. These screens are available to fit most VDT terminals. They eliminate glare and reflections from the screen, and they improve contrast—in that the mesh is dark charcoal in color. They allow flexibility of screen location within a space. However, they also increase the perception of flicker. Each user, therefore, must weigh whether the good outweighs the bad in this solution.

Other solutions deal with the source of the glare:

- With recessed luminaires, the existing lens can be replaced with a specular parabolic wedge louver. This redistributes the light to a cutoff of 45 degrees. Above the parabolic louver, a translucent white diffuser panel can be installed—to eliminate specular reflections of lamp images in the louver, and to prohibit raw light from coming through the louver gnd. This also can avoid ceiling reflections.
- To avoid window reflection, sheer drapes, or better, vertical blinds can be installed and adjusted to direct incoming light away from VDT screens. While this permits adjustment of luminance at the windows, it keeps the operator from looking out from the workstation. A mesh-type window shading device is now available to serve both purposes.
- VDT terminals can be located away from windows, or in a windowless room. Terminals should be positioned back to back.
- Ceiling down-lights can be replaced with indirect lighting fixtures that direct light laterally.
- Walls and surfaces can be refinished to a diffuse, matte finish, with reflectance values of 50 percent or lower.

Seeing conditions are improved by eliminating extreme contrast in the immediate task-surround—a 5-degree cone around the task—including the space between the source document and the VDT screen. A recommended luminance ratio should be maintained—3:1 between task and darker surrounds. This holds the transient-adaptation factor to a reduction of only 10 percent of effective contrast when changing from one source-document to another. The luminance of a source-document and that of the VDT screen should be kept about equal.

By following these recommendations for VDT screens, it may be advisable to reduce the ambient level of light. However, it is known that older workers need more light. For older workers, a small task light may be all that is required to illuminate the task-surround well enough to achieve good visibility.

Other Special Lighting Requirements

RFI-Free Fluorescent Lighting

RFI-free fluorescent lighting should be provided for all rooms and adjacent hallways except for rooms infrequently occupied. It should comply with the following requirements:

- RFI-free fluorescent lighting should be provided by enclose 12- or 4-lamp, 40-watt fixtures. Fixtures should have no unprotected openings between metal parts. The opening for light emission should be covered with a borosilicate glass that has a permanently bonded transparent electrically-conductive coating—with a 1/4-inch-wide silver ground-ribbon bonded to the coating along each long edge, fastened to the bare metal of a hinged door frame at two points. The hinged frame also should be bonded to the bare metal of the fixture housing at two points. The coating should have nominal resistance of 50 ohms per square and should shield-radiated radio interference to within the limits of the MIL-STD-461. The fixture should have a lumen-output equal to or greater than 55 percent of the bare-lamp lumens when tested with the electrically conductive glass in place. Each fixture should be connected by a ground wire to earth. The ground wire should be fastened to the bare metal of the fixture housing.
- Transmittance of the electroconductive-coated glass should be no less than 70 percent in any direction, and photometric test data should be gathered.
- RF-suppression line-filters should be double pi-section filters connected in series with the incoming hot-line and neutral to the fixture. The filters should be made up of a 200-microhenry inductor and two 0.25-microfarad capacitors, with the free end of the capacitors connected to the ground.
- The fixture should be given production sample-tests, and reports should be submitted to show that the fixtures meet or exceed the RFI suppression limits established by MIL-STD-461.

Exit Lighting

Exit lights should be placed throughout the building in compliance with NFPA Standard 101. The one exception to the placement of exit lights is that illuminated signs cannot be positioned so that they are within sight of any security surveillance television cameras. (The constant lights would burn out the camera's orthicon tube.) A nonilluminated exit-sign may be necessary where these conditions exist.

Signs should be surface-mounted, recessed, or stem-mounted as required, and should have downlight ability.

The signs should be a self-powered combination with a power pack for each sign.

Standard requirements are as follows:

- Power pack to be mounted either on top of the sign or in a recessed box. The power pack should contain a fully automatic, solid-state charger able to recharge the battery in 24 hours.
- The power pack should have a test switch and pilot light.
- The battery should be hermetically sealed lead-cadmium-gel type or equal.
- Stem-mounted signs should be extended so that they can be readily seen by personnel in the area. (See Fire protection/Life safety section for additional guidance.)

Emergency Lighting

Battery-operated, solid-state, emergency lights should be used throughout the facility and should be equal to or exceed OSHA and NEC standards. These lights should activate automatically if a power-failure occurs. Equipment should meet the following requirements:

- A 120-volt a-c, 60-cycle input operation with a test switch light capability and trickle charge for the battery.

- Solid-state charger rated at .001 to 10 amp as the battery requires, based on electrochemical impedance, voltage, and electrolyte conductivity.
- The battery should be lead acid or nickel cadmium rechargeable, designed specifically for emergency lighting. The battery should have a transparent container and a disc float hydrometer with a rating of 100 ampere hours.
- Two lampheads should be fully adjustable vertically and horizontally. The lamps should be the sealed-beam type with a 25-watt nominal rating.
- Capacity in watts, to 87.5 percent per NEC, should be rated at the following values, with a full 1.5-hour battery capacity:
  - 1.5 hr: 245
  - 2 hr: 198
  - 4 hr: 114
  - 5 hr: 99
  - 8 hr: 66.

HEATING, VENTILATING, AND AIR CONDITIONING SYSTEM

A heating, ventilating, air-conditioning system (HVAC) provides atmospheric environmental control. In this discussion, then, HVAC includes heating, cooling, ventilation, humidification, dehumidification, circulation, filtration, pressurization, and distribution of air in areas occupied by communications and data processing equipment, and in areas occupied by any equipment that directly supports the communications and data processing equipment. This material provides the basis for HVAC design, and should be supplemented by the specific design criteria for the communications equipment or systems involved. It is not the intent here to provide specifications for an HVAC system: each system requires individual design to meet individual requirements.

For command centers, mission requirements dictate a 99.99% operational capability. In addition, command centers should have the ability to withstand hostile actions or stresses, and remain operational. The HVAC system must provide the environmental conditions necessary to meet the mission requirements.

There are no standard HVAC systems that are best for all command center facilities. All conditions, criteria, and variables of each Center must be analyzed, and the individual system designed to meet all the requirements. This analysis must include the following:

- The operating environment required by the communications equipment
- The site location, and the outdoor environment
- HVAC capacity requirements for critical areas, technical areas, and all areas combined
- Availability of a central cooling source, a central heating source, and alternate energy sources
- Availability of water of appropriate quality, quantity, and pressure
- Availability and quality of commercial by-supplied utilities
- Availability of spare parts and maintenance items
- Availability of skilled maintenance personnel
- Installation costs, and operation and maintenance costs, including energy consumption.

Operation of the HVAC system must not interfere with the communications system. Operation of HVAC components must not cause voltage fluctuations in the electrical power system serving the communications equipment. Electric wiring to the HVAC system must not cause electromagnetic interference to the communications system. These considerations must include radiated and conducted forms of interference, plant layout, cable shielding, and cable routing.

Electromagnetic interference characteristics of the HVAC system design should be minimized by meeting all applicable regulations and guidelines as prescribed by Military Standards.

The HVAC system supplies atmospheric environmental control within the facility. Providing such a system requires the following steps:

- Determine the atmospheric condition required within the facility - the indoor design conditions.
- Select and/or design HVAC equipment to provide the required atmospheric condition within the facility.

- Select and/or design HVAC equipment based on special conditions in special facilities.

Indoor Design Conditions

In all cases, recommended operating temperatures and humidity conditions should be obtained from the manufacturers of the communication and data-processing equipment and should be used in designing the environmental control system.

For Critical Spaces

Rooms known as critical spaces usually require close-tolerance temperature- and humidity-control. Magnetic units are the communication-system components most sensitive to temperature, humidity, and dust. Usually, these can operate within a temperature range of 60° to 80oF (15.6° to 26.7°C) dry-bulb, and a relative humidity range of 40 to 65 percent. The level selected within the range, however, must be held relatively constant.

Unless otherwise specified by the electronic-equipment supplier, operating-room temperature and humidity are measured approximately 5 feet (1.52 meters) above the floor, adjacent to that communications-system component most sensitive to ambient conditions. A 24-hour temperature and humidity recorder should be installed in this area; others may be installed elsewhere in the critical area. At present, critical areas—such as those using electronic data processing equipment such as AUTODIN—usually are held at 73°F (22.8°C) plus or minus 2°F (1.1°C), and at a relative humidity of 50 percent plus or minus 5 percent. Usually this is a safe operating ambient condition for computer rooms.

Lower temperatures and humidities would increase operating costs. A temperature much above 73°F (22.8°C) might result in an unsafe differential between that temperature and the recommended computer-shutdown temperature—often 80oF (26.7oC). The temperature will vary a few degrees in different parts of the area—adding to the criticality of a narrow temperature-differential.

Some of the areas considered critical do have a broader tolerance of temperature and humidity. Operational environmental tolerances for installations not using magnetic memory devices or computer equipment are usually quite broad. Generally, AUTOVON equipment can operate within a dry bulb range of 45o to 105oF (7.2° to 40.6°C) and a relative humidity range of 20 to 90 percent. To assure adequate reserve capacity for safe, reliable operation of the communications equipment, the recommended indoor design conditions for those communication facilities not using data-processing equipment is a temperature of 75°F (23.9°C) dry-bulb; and a relative humidity of 50 percent for summer, and 20 percent for winter.

Winter humidification and summer dehumidification may be required. In summer, the air-conditioning system usually provides enough dehumidification to meet the relative-humidity requirement; no supplementary system is then required. A very humid climate, however, may require a dehumidification system.

For operation of installations requiring year-around cooling, the thermostat should be set to the dry-bulb temperature currently recommended for comfort cooling based on considerations involving energy conservation, economics, and comfort—usually 78° to 80°F (25.6° to 26.7°C). For smaller installations that require winter heating and summer cooling, the thermostat setting for summer should be the same, but the setting for winter should be 68oF (20oC). The humidifier may be necessary in winter to meet the minimum relative humidity requirement. At least one temperature and humidity recorder should be installed at a suitable location in the critical area.

For Technical Spaces

Rooms known as technical spaces require varying levels of temperature control. Usually, technical areas—such as rooms for support, UPS, battery, backup power and equipment—do not require close-tolerance temperature and humidity control but do have specific high- and low-temperature limits. In most cases, the maximum allowable indoor air temperature is 104°F (40°C) and the minimum is 50°F (10°C). In battery rooms, the minimum is 60°F (15.6°C). Mechanical ventilation should be used for temperature control as required.

Some technical equipment, however, requires temperatures lower than mechanical ventilation can provide; then, mechanical cooling must be used. Further, in locations with extreme atmospheric conditions—hot, humid, tropical climates, salt-laden marine atmospheres, and atmospheres containing substantial amounts of corrosive, abrasive, or irritating pollutants—consideration should be given to air-conditioning the solid-state UPS and battery areas rather than attempting to cool them by mechanical ventilation.

Indoor Air Quality

Command center indoor air quality (IAQ) involves both the "cleanliness" of the air circulated, and the "velocity" at which a space's total air is changed per time period in minutes.

Air Cleanliness

For critical areas, technical areas, UPS rooms, and battery rooms, the supply-air should be filtered. Air-filter performance-values should be determined in accordance with ASHRAE Standard 52-76. All supply air—outdoor ventilation air and indoor recirculated air—should be filtered with filters that have an atmospheric dust spot efficiency no less than 20 percent. Air should have a minimum average dust weight resistance of 60 percent. Also, when computers are used, another bank of high-efficiency filters should be installed.

For installations using self-contained, specialized computer-room air-conditioners, only one bank of the higher-efficiency filters need be used for the recirculation room air passing through the units. The final filter efficiency should be as recommended by the computer manufacturer. Usually, the computer's magnetic memory units determine the efficiency requirements of the final filters.

At facilities that use computers, final filters have a minimum initial efficiency of 60 percent. Generally, newer computer rooms require less efficient filters—around 45 percent average efficiency over the filter's service life (between clean and dirty conditions).

Room-air velocity

Because of the cool temperatures necessary in critical areas, air-flow velocities should be kept at acceptable levels. In these spaces, wherever possible, the room-air velocity should not exceed 50 feet per minute (0.254 meters per second), measured at a level of 30 to 60 inches (0.76 to 1.52 meters) above the floor. It should not exceed 70 feet per minute (0.356 meters per second) throughout the rest of the occupied zones.

The supply rate of outdoor ventilation-air should be high enough to pressurize critical areas to between 0.05 and 0.10 inches of water gage pressure above adjoining areas, (12.4 and 24.9 pascal) to prevent the infiltration of unconditioned outdoor air or inadequately conditioned air. The outdoor air-supply rate should not be less than 5 cubic feet per minute per person.

HVAC Equipment

Heating Component

The heating system of the primary HVAC system should provide heat for the entire facility. The heating system of the secondary HVAC system need provide only the heat needed to keep critical areas operational. The heating system usually provides heat for technical and office areas, for winter humidification, and for reheat during summer dehumidification. Heating systems usually use hot water or steam, with hot water or electric coils often used for any required heating. Steam is usually used for humidification.

Refrigeration Component

The primary refrigeration system, for primary HVAC, should be capable of cooling the entire facility. The secondary refrigeration system, for secondary HVAC, need be capable of cooling only those critical areas that must remain continually operational. At least two water-chillers should be provided for installations requiring both primary and secondary refrigeration systems. Each system should have its own water-chiller, condenser, and chilled-water pumping-equipment.

Ventilation/Air-Conditioning Component

An air-conditioning system provides air that has been conditioned to maintain the environmental condition required. The system normally consists of: an air-conditioning unit to condition the air, and an air-distribution system to distribute the conditioned air. An air-conditioning unit heats, cools, ventilates, filters, humidifies, and supplies air to maintain the desired environmental condition. At least two air-conditioning units should be provided for an installation requiring both primary and secondary HVAC systems. The primary unit should provide air-conditioning for the entire facility, the secondary unit need provide air-conditioning only for critical areas that must stay in continuous operation. Unitary-packaged, self-contained units should be considered for a small system. Multiple-packaged units or central buildup units—providing multiple zone control—should be considered for a large system.

A computer-room HVAC unit usually is factory-equipped with a complete set of automatic controls, such as an operating-mode lighted-signal system. When other types of HVAC systems are installed, a complete automatic-control system with manual-override supervisory-controls should be included. Adjustable controllers should be provided to regulate temperature and humidity, and to regulate ambient pressure in some installations. Automatic controls with manual override should be included for use in the switchover to a secondary system, should such an operation be required. Thermometers, pressure gages, and draft gages should be well-located to facilitate convenient system-monitoring. An alarm panel should be installed in a technical-operation room that has 24-hour occupancy. The central control panel should have a single audible alarm, and individual equipment-indicating lights, gages, and an associated pushbutton station. The alarm panel should have both audible and visual alarms—responding to temperature-and humidity-sensors located in the conditioned areas—to alert operating personnel when extremes of allowable operating ranges are being approached.

An air-conditioning unit includes: an outside-intake, an exhaust-air outlet, air filters, a cooling coil, and a heating coil.

Outside-Air Intake

An outside-air intake should be so located as to provide the cleanest source of outside air. Weatherized louvers with bird and insect screens should be used.

Exhaust Air Outlets

An exhaust-air outlet should be so located that exhaust-air will not be drawn into the outside-air intake. The outlets should be a weatherized type, with backdraft dampers.

Air Filters

Air filters should be installed in all air-conditioning units, to filter outdoor- and return-air before conditioning. Filters usually are installed in a special section on the air-inlet side of the air-conditioning unit.

Electronic air-cleaners should not be used—because of the danger of producing charged particles that would be attracted to opposite-charged communication equipment. Electronic air-cleaner use requires prior approval by the respective military department.

A CBR filtering system may be required to remove contaminants from critical and technical areas. The filtering system is activated whenever a hostile action or stress starts; it is inactive otherwise. The CBR filtering system includes:

- Precleaner-dust filter.
- Particulate filter, removes aerosols and particulate matter.
- Gas filter, removes toxic warfare gases.
- Air supply blower/fan, provides required air flow through the filtering medium.

The filtering system should provide a high enough flow rate of filtered air to compensate for air leakage and outside air ventilation rates. Entrance airlocks should be provided to filtered areas; vestibules are a suitable way to accomplish this. The filtering system should either be coupled to the air-handling system for critical and technical areas, or installed separately. For either type installation, the air-handling systems for critical and technical areas must be able to operate at 0 percent outside air upon activation of the CBR filtering system.

Cooling Coil

A direct-expansion evaporator-coil should be used for packaged units and small systems. A chilled-water cooling-coil should be used with multiple units and with larger systems requiring multiple zone control.

Heating Coil

A hot-water or electric heating-coil should be used for packaged units and small systems. A hot-water or steam heating-coil should be used with multiple units and large systems requiring multiple zone control. A hot-water or electric coil should be used to reheat for dehumidification.

Humidification System

A humidification system should be provided for both the primary and secondary HVAC systems. This system should be of the direct steam-injection or of the heated-pan type. Atomizing humidifiers should not be used due to the mineral-dust problem. A steam-grid system is usually used in a large HVAC systems. The heated-pan type—with electric, or hot water coils—is usually used in smaller HVAC systems, such as unitary packaged HVAC systems.

Air-Distribution Component

Conditioned air from the air-conditioning unit should be delivered to the various spaces or equipment, then returned to the air-conditioning unit—through ductwork, diffusers, registers, grilles, ceiling plenums, and floor plenums. The quality and quantity of conditioned air delivered to a space, zone, or piece of equipment must insure that communication equipment will be operated within its prescribed environmental conditions.

For critical areas, a single-duct, low-velocity, constant-volume system with terminal reheat usually is used. For technical areas, a constant-volume variable-temperature system, or a variable-volume constant-temperature system should be considered. The required environment for the communication equipment usually determines the type of air-distribution system used.

Overhead Distribution System

An overhead air distribution system should be considered where a raised access-floor is not used. Supply-air ductwork usually should be installed above a dropped acoustical ceiling, with the remaining space above the ceiling used as a return-air plenum. A return-duct could be used instead of a return-plenum. Diffusers, registers, and grilles should be installed at the ceiling or sidewalls. For some types of communications equipment, a ducted supply and return can be connected to the equipment.

Underfloor Distribution System

An underfloor air-distribution system should be considered where a raised access-floor is used. The space beneath the raised floor is used as a supply-air plenum. An overhead duct or ceiling plenum serves as a return. Supply-air diffusers or registers are installed in the raised floor, and return-air grilles are installed in the ceiling. A pressure-differential gage or manometer should be installed with the raised floor. For some communications equipment, the supply-air can be fed directly to the equipment through the raised floor. (See Fire Protection and Fire Safety.)

Ductwork, Diffusers, Registers, Grilles

Ceiling supply-air outlets and return-air inlets should be readily relocatable without major alteration. This is necessary when varying the air-distribution pattern to accommodate technical-equipment relocation, to eliminate hot spots, and to maintain a uniform temperature throughout the room. Air-supply ducts outside the air-conditioned spaces should be insulated with noncombustible material that has an integral vapor barrier. Interior duct-linings should not be installed in air-supply ducts serving the technical-equipment rooms. Sound attenuators should be used when considered necessary. Each return-air duct should be insulated as required, depending on its position relative to the ceiling or roof insulation. Ducts below roof-insulation normally will not require insulation, but ducts above ceiling-insulation should be insulated.

Ambient Sound Level

In critical areas, the maximum allowable ambient-sound level of the HVAC system is 50 decibels (A-rated). The ambient-sound level is defined as the sound level in an unoccupied space with the HVAC system operating and the communication equipment shut down. Measurements should be made on the A scale of a standard sound-level meter meeting American National Standards Institute (ANSI) Standard S1.4, used according to the manufacturer's instructions.

Energy Conservation

Operating economy and energy conservation are desirable, but these goals are secondary to electronic-system reliability. When an energy-monitoring and -control system already exists, or is scheduled for installation, consideration should be given to its use, provided HVAC-system complexity is not increased to the detriment of reliability. If operating economy and energy conservation are sought, the following guidelines can be used:

1. Base the intake of outside air on average expected building occupancy, rather than on a percentage of total air circulated. When occupancy varies, an oxygen- and carbon dioxide-sensor system can be considered, to keep outside-air intake at the minimum required level.

2. Avoid conflict between components in the HVAC system—such as excessive cooling that must be offset with humidification, or that must be offset with reheating.

3. Avoid conflict or cross-control between air-conditioning units when multiple units are used—as in computer rooms.

4. Use capacity increments for improved part-load performance.

5. Avoid practices such as economizer cycles (except as backup), night setback, and wide-throttling-range or dual-setpoint thermostats; these are incompatible with the close control required by electronic equipment.

6. For areas not containing electronic equipment, use proper zoning, to permit economizers, night setback, and other energy-conservation options.

An economizer air cycle can be considered for all HVAC systems whenever outside weather conditions permit. This cycle allows the air-conditioning unit to use up to 100-percent outside air, reducing the refrigeration load when the temperature of the outside air permits. This approach also can provide emergency temperature-control—to some extent—should the refrigeration equipment fail. An economizer air cycle can work well for temperature control; it also can control both temperature and humidity provided enthalpy controls are used to prevent high temperature and humidity levels. Economizer-air-cycle use requires approval of the respective military departments.

ELECTRICAL SYSTEM

The command center electrical system must provide dependable, high quality, electrical power to assure continuity of communication and other functions. Primary power can be furnished by an off-station source (a commercial company or a government-owned power system), or can be generated locally at the facility. The power source should be determined from an economic and technical analysis of all available power sources, with consideration given to use of renewable energy sources.

A "commercial" power source usually requires connecting to the nearest power-transmission line. For larger terminal stations in the United States, the choice of commercial power is almost taken for granted, for power lines are likely to be available at such sites. The utility company delivers off-station power to the facility. An investigation must be made of the supplier's ability to serve the load requirements—both present and over the next few years (usually five years). Voltage-stability and frequency-stability, and other system-characteristics should be determined. Commercial plants connected to the primary feeder must be examined for any transient or erratic regulation they may cause in the distribution system. For facilities at remote sites, an independent power-plant may be necessary. For most facilities, however, a comparison should be made between commercial and independent sources—based upon installation-, maintenance-, and service-costs, and upon reliability of the source.

In planning and engineering government-owned power systems, the following must be considered: simplicity, reliability, flexibility, operability, maintainability, quality, cost-effectiveness, synchronization, location, sources, power conditioning, UPS, float-battery, electromagnetic compatibility, survivability, recoverability, and environment. The availability and reliability of the power system must be based on the command center's operational requirements. The power system must provide continuity of vital communications. Minimum electrical design requirements and performance parameters must follow MIL-HDBK-411A.

On-site prime-power plants usually use multiple sets of DoD-standard family-diesel generators as the source of power. Other sources—such as gas-turbine generators, steam-turbine generators, and nonstandard diesel generators—also can be used. An on-site prime-power plant will require at least three generator sets: (1) one set online, carrying the station load; (2) one set as a standby; and (3) one set as a maintenance spare. An even more reliable configuration could use four or five generator sets: (1) two sets online in a load-starting mode; (2) one set as a cold standby unit; and (3) one or two sets as maintenance spares.

An uninterruptible power source (UPS) must be used to supply the critical technical load. The method used depends on power requirements of the technical-load, and on the voltage- and frequency-deviations the technical-load can tolerate. During normal operations, the UPS is to be supplied with a-c power by the primary power source. The UPS changes the a-c power into a storable d-c energy—to be used as a short-term, no-break power-supply for critical equipment. The a-c power input and the UPS output are isolated from each other by the energy-storage medium. A way should be provided by bypass the UPS—for maintenance, or in the event of failure. When possible, the UPS should be located outside the operations room, preferably with the other power-equipment.

Many voltage- and phase-arrangements are in use in current command center facilities, meeting the requirements of currently installed electronic equipment. Facilities using power of nonstandard frequency and voltage must be specifically engineered to meet electronic-equipment requirements.

The total power distribution system should be divided into two separate parts: (a) technical power, with a panel for the C-E equipment; and (b) utility power, with a panel for HVAC, lighting, and other systems. By using two systems, required filter can be installed for technical power only.

The command center electrical system is determined by the various requirements of the communication-electronic equipment involved, and is made up of two major components: a source of electrical power, and an electrical power distribution system.

Requirements of the Electrical System

The electrical power system must provide dependable, high-quality, electric power to assure continuity of communications and of other command center functions. The quality of electric power supporting digital, synchronous, and automated switching equipment should be free from power abnormalities, that cause loss of synchronization, discontinuity of the switching function, or physical damage to the electronic equipment. The power requirements of the communications and support equipment must be known and considered during all phases of design. The electric system must provide for the specific power characteristics of the equipment.

All components of the electrical system must meet the requirements of the National Electrical Code. The system should incorporate the general characteristics discussed in the following sections.

Simplicity

The electrical power system should be of uncomplicated design, consistent with established requirements and assigned mission. Complex circuitry and switching schemes should be avoided. Distribution circuits and system components should be protected by positive-acting protective devices capable of selective coordination throughout the primary distribution and auxiliary power and lighting system.

Reliability

The electrical power system should provide optimum reliability at the lowest appropriate cost, considering initial installation, maintenance, and operation. The system requires an auxiliary power supply that includes emergency generators and UPS. The amount and class of auxiliary power required is determined by the degree of reliability dictated by strategic and operational considerations.

Flexibility

The system should be capable of providing and distributing the present load, and capable of ready reconfiguration to accommodate anticipated mission activity and improvements. Operational flexibility requires alternate sources, feeders, buses, switching arrangements, and testing arrangements.

Operability

Complex operating schemes should be avoided. Switching operations may be either manual or automatic, and should be as simple as possible. Positive checks should reduce the possibility of error to a minimum.

Maintainability

The electrical system should keep the facility in service during de-energization of selected system components for maintenance, testing, and replacement of parts. Failure of any one major component (transformers, prime power source, auxiliary power source, or secondary switchgear) of the system should not cause the facility to become non-operational. Strategically placed test points should be included to enhance troubleshooting and problem isolation.

Quality

The system delivers power to voltage- and frequency-sensitive electronic equipment and should provide the quality of power required. Auxiliary devices—such as air conditioning, ventilating systems, and pumps—are inherent transient-creating sources during starting conditions. This equipment should, therefore, be electrically isolated from electronic equipment to the degree required to prevent their operation from adversely affecting the communications-electronics (C-E) equipment operation. In no case should the transient-producing, motor-driven equipment be served from the same distribution panel as sensitive C-E equipment. Current trends in C-E equipment require an increase in the quality and decrease in the quantity of electric power.

Cost Effectiveness

The system should be appropriately cost-effective.

Status Indicators

A power-status panel with appropriate meters and alarms should be provided in the control area of each operating building, to indicate voltage and frequency delivered to the critical technical loads. Audible and visual alarms should be provided on the panel to indicate the starting of the auxiliary power units. Additional alarms should be provided to indicate the malfunction of unattended auxiliary power units. An alarm-acknowledge capability, either automatic or manual, should be provided in order to inhibit the audio alarms once the operator knows an alarm-condition exists.

Electromagnetic Compatibility

The system must prevent electromagnetic interference to the communications system it serves. The power system must comply with applicable Class A3 and C2 requirements contained in MIL-STD-461B.

Survivability

Building construction, component selection, and system location can contribute to the survivability of an electrical system. Make these basic considerations during the design of the system to enhance overall survivability without a major impact on cost.

Recoverability

Operation in adverse political environments can result in unplanned facility closure and/or relocation. Major components of electrical facilities should be recoverable whenever possible, so that cost savings and operational flexibility can be attained when facility relocation is required.

Hierarchy of Electrical-System Loads

The command center's electrical-system loads can be categorized as shown in Figure 7-33. These categories are discussed below.

- Station load - The total power requirement of the facility—the sum of the operational and non-operational loads.

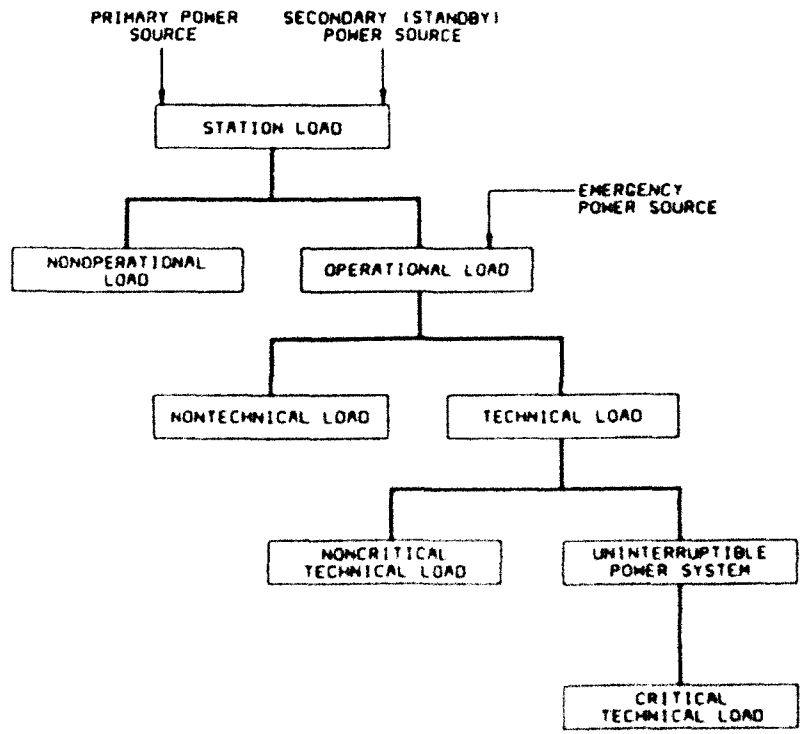


Figure 7-33. Electrical Power Load Categories

- Operational load - The operational load is that part of the station load required to keep the facility in continuous operation. It involves the facility's central functions, such as communications. It is the sum of the technical and non-technical loads—categorized by function and allowable down-time.
- Nonoperational load - The nonoperational load is that part of the station load not essential to the facility's continuous operation—such as the load caused by the general administration and personnel functions.
- Nontechnical load - The nontechnical load is that part of the operational load created by general lighting, convenience outlets,air-conditioning/ ventilating equipment, and other functions for normal operation. Several hours of downtime may be permitted.
- Technical load - That part of the operational load required for electronic equipment and ancillary equipment—including lighting, air-conditioning,and ventilation—required for full continuity of facility-function. The technical load is essential to the mission of the facility. It is the sum of the critical and the non-critical technical load.
  - Critical technical load – The critical technical load is that part of the technical load required for continuous synchronous operation of electronic equipment. This includes all equipment that during a momentary power-dropout will: (a) malfunction and cause additional outage after power is restored, as a result of the need to resynchronize; (b) lose real-time count by master time sources; or (c) lose data in ADP systems. The critical technical load requires an uninterruptible power source (UPS).
  - Non-critical technical load – The noncritical technical load is that part of the technical load not required for synchronous operation. This includes: (a) nonsynchronous electronic equipment; (b) test equipment; and (c) emergency lighting, ventilation and air-conditioning for electronic equipment. An outage of up to 2 minutes can be tolerated.

Source of Electric Power

The electric-power source must enable continuity of communications and other vital functions. The availability and reliability of the power source must be based on the operational requirements of facility systems—particularly of communications. Minimum electrical design requirements and performance parameters must be in accordance with MIL-HDBK-411A.

A load-shed and -restoration plan should be developed and an operating procedure established for sequential load-shedding and load-restoration of power from various sources. This plan should cover load-shedding, normal- and bypass-switching, where appropriate, and also include synchronizing requirements. Periodic scheduled testing of power sources under simulated or actual load conditions should be performed, in accordance with DCAC 350-195-2. These tests are performed to assure that the electrical systems are reliable and are in an operable condition.

Hierarchy of Electric Power Sources

For command centers, electric power sources can be categorized as shown in Figure 7-34. These categories are discussed below:

- Class A—Primary power source: The primary power source supplies power for all facility operations. It may be furnished by an off-station source (commercial or government owned) or generated locally at the facility.
- Class B—Auxiliary power source: This auxiliary power source provides power for all facility operation's during interruption or extended degradation of primary power.
- Class C—Auto-start auxiliary power source: This auxiliary power source provides, per the technical load, redundancy to the Class B power source. It provides rapid restoration of power to the technical load.
- Class D—Uninterruptible power source (UPS): This auxiliary power source provides a required redundancy for the critical technical load. It provides continuous conditioned power to C-E equipment, and provides protection from power-line transients. All operating aspects must be fully automatic.

POWER CLASS	OPERATIONAL POWER REQUIREMENT	CHARACTERISTICS
Primary power class A	Includes all utility, technical, and critical technical operational loads resulting in a steady-state operational requirement.	Steady-state power, subject to various voltage and frequency deviations, transients, and occasional complete power failure.
Auxiliary power, class B	Same as class A; capable of indefinite operation; should have 15 days' fuel supply available. Auto system operational at -10% or +10% voltage variation after 5-sec delay. Covers extended outages that may last for days.	Supplement to primary power. Subject to complete loss of synchronized power for approximately 20 sec during automatic power transfer after primary power loss.
Auxiliary power, class C	Provides auto-start power plant to provide rapid restoration of power to the technical load. Starts on voltage variation of +3.3% with an adjustable time delay of approximately 5 sec. Minimum fuel supply of 7 days. Covers outages of relatively short periods (hours).	Supplement to primary power. Assumes load in shortest practicable time after failure of primary power (10 to 60 sec).
Uninterruptible power system (UPS) and no-break power, class D	Provides continuous uninterruptible power and prevents the occurrence of transients and surges on the critical technical load.	Automatically assumes load when required and automatically shifts load back when primary power becomes available. No power interruption, and minimum voltage and frequency deviations.

Figure 7-34. Classes of Electrical Power

Power-Distribution System

The primary power-distribution system must be designed for al levels of electrical load. The load must be segregated: duplicated transformers, feeders, circuit breakers, etc., are considered necessary to provide the reliability and maintenance-ability required for critical communications loads. Underground feeders should be used to enhance reliability, and to avoid interference with the communications facility. The distribution system should include the standard protective relays such as those for overvoltage, overcurrent, and reverse power whenever the primary and auxiliary power systems are designed to operate in parallel.

Power for the technical equipment must be provided at 208/120 volt, 3-phase, 4-wire, 50 or 60 hertz. Regulation, as measured at the technical equipment power panels, must meet the following requirements:

- Voltage: 120/208 volts +10 percent.
- Frequency. 50 or 60 hertz +5 percent.
- Voltage balance. Line-to-neutral voltages must not deviate from normal by more than +2.0 percent for any balanced load that varies from 0 to 100 percent unbalanced loads.
- Harmonic distortion. Total harmonic distortion must not exceed 5.0 percent. No single harmonic may exceed 3.0 percent.
- Phase displacement. Must not exceed +1.0 percent for balanced loads or +5.0 degrees for 50 percent unbalanced loads.

The equipment will interface with the building power-distribution system at power panel boards installed in each technical equipment room. The technical-power panel boards must be equipped with circuit breakers.

Protection Against Distribution-Interference

At command centers, it is possible for classified information from processing devices to be coupled inductively into power lines; consequently, power distribution conductors entering areas where classified information is processed may need to be filtered at the area boundary. Specific guidance concerning the treatment of such power and signal cabling will be contained in the BESEP. In general, primary-power distribution and protection should be located outside classified areas to facilitate access for maintenance. Normal power-distribution for electronic equipment requires consideration of the peculiarities of communication and electronic equipment. For example, low level signals in the microvolt range and a large frequency spectral environment would suggest that power lines be routed as far away as possible from the nearest antenna. Radio-frequency noise-sources such as generators, air-conditioning compressors, and switchgear should be located to minimize physical and electrical interference with electronic equipment. Voltage-transient protection should be installed on both transient-sources and power-distribution points for electronic equipment. Commercial power-conditioning equipment with instrumentation and alarm capabilities, as well as active and passive protection devices, may be necessary to provide the quality of power suited to the equipment being supported.

Protective Devices and Alarms

A power-status panel with suitable meters and alarms should be provided in the control area of each operating buildings, to indicate voltage and frequency delivered to the critical technical loads. Audible and visual alarms should be provided on the panel to function when controls have initiated the starting of auxiliary power units. Additional alarms should be provided to indicate the malfunction of unattended auxiliary power units. An automatic or manual alarm acknowledgement should be provided to inhibit audio alarms once the operator knows an alarm condition exists.

There must be a protective device in every circuit, to open the circuit if there is an unexpected overload—such as a short circuit, or a jammed motor that prolongs a high inrush current. Protective devices may be fuses combined with knife switches, or circuit breakers, that provide both functions in one device.

- The simplest and most common circuit-protection device is the fuse. Although fuses are available in many varieties, they all work the same way. A fuse has two terminals, with a piece of specially designed metal, the fusible element, in between. Power flows into the line terminal, through the fusible element, and out the load terminal. An overload burns out the fusible element, opening the circuit.
- A circuit breaker performs the same protection-function as a fuse, and in addition, acts as a switch. Thus it can be used as a switch-and-fuse combination, both to protect and to disconnect a circuit. A circuit breaker can be thermal, magnetic, or a combination of the two. An overload trips the circuit breaker, opening the circuit.

Separate circuit breakers must be provided at power panels for each equipment rack, cabinet, or piece of electronic equipment. Individual pieces of equipment must be connected to the panelboards by wiring run in cable racks or conduits or a combination of both. Bolt-on circuit breakers should be used in electronic facilities.

Feeders and branch circuits should have circuit-protective devices coordinated to insure disconnection of the faulted circuit as close to the fault as practical. Guarding of live parts and protective devices must be installed and identified in accordance with the safety requirements of the National Electrical Code. Grounding must conform to the standards set forth in MIL-STD-188-124. Transient protectors, such as metal-oxide varistors (MOV), should be installed to protect transient-sensitive equipment. For low-voltage power distribution, three basic ratings of MOVs (Series L, Series PA, and Series HE) are available and are designed in the order of increasing joules. Series PA is recommended for low-voltage power-distribution feeder and Series L for installation in branch circuit panel boards.

Electrical Wiring System

The electrical wiring system has certain general requirements:

- Most buildings require underground radio frequency cable, communication cable (telephone type), control cable, and power cable. These cables must enter the building through two cable vaults, one for signal cables and one for power cables. The vaults also must house the protective devices used to prevent surges from entering the building. The vaults must be designed in accordance with the latest safety standards.
- Wiring to each piece of equipment must be sized to carry full-load current. Maximum voltage-drop must be in accordance with the NEC.
- All receptacles other than 120-volt, general-purpose convenience outlets must be marked with voltage, amperage, phase, and frequency.
- Full-size neutral conductors must be used throughout the distribution system.
- Cable must be routed through trays or ducts suspended overhead. When raised flooring is used, cable must be run in conduit within the space under the floor in accordance with the requirements of the NEC.
- Bus ducts may be used as required.
- When more than one building is fed from a common transformer, the neutral and the green ground-wires must be bonded together and grounded at the secondary side of the transformer only. No ground should be provided at the first disconnect.

Conductors

Conductors carry the power through the electrical system. The standard of the American wire and cable industry is the American Wire Gage (AWG). A conductor usually is covered with insulation that prevents it from contacting other wiring, a grounded raceway, piping, or other conductors at earth potential.

For each size of insulated wire, building codes stipulate a safe current-carrying capacity—in amperes—the ampacity of the wire. The code-ampacity is based on the maximum heating effect permitted before damage to the insulation. Safety regulations for use of wire must be based on the National Fire Protection Association's "National Electric Code"—latest edition. Underwriters Laboratories, Inc., tests electric materials, devices, and equipment. Approved items carry a UL label.

For a given wire size, power loss can vary depending on: the insulation used; and the location of the wire—in open air, or confined in a closed conduit. Tables in the "National Fire Code" give the safe ampacity for each type of insulation and the derated ampacity for more than three live wires in a raceway.

Raceways and Other Wire Assemblies

Codes often require that wires be protected from mechanical damage by enclosure in raceways. A raceway is a support or enclosure of wires. The definition includes conduit, but includes other enclosures as well. Wire dimensions and the number of wires of each size are fixed by tables in the National Electrical Code. Three or more conductors may not occupy more than 40 percent of the interior area—with some exceptions for lead-sheathed cable. All metallic raceways must be continuously grounded. The raceway physically protects the wires, provides a grounded enclosure, protects the surroundings from faults in the wiring, and protects occupants from damage by the electrical system.

A conduit is a wire-enclosing pipe raceway. Lengths of conduit are joined together by screwed steel couplings. When a conduit enters a box or cabinet, the NEC requires that a conduit with wires larger than No. 6 AWG have an insulated bushing.

The NEC authorizes the use of various raceways and other wire assemblies.

Raceways for general use:

Rigid metal conduit

Intermediate metal conduit

Electric metallic tubing (EMT)

Nonmetallic conduit

Surface raceways.

Cable-assembly systems for general use:

Nonmetallic sheathed cable

Underground feeder and branch-circuit cable

Metal-clad cable (armored cable)

Mineral insulated metal-sheathed cable (MI)

Aluminum-sheathed cable (ALS).

Conductor systems for general use:

Open wiring on insulators

Concealed, knob-and-tube wiring.

Cable-assembly systems for limited use:

Service entrance cable

Nonmetallic extensions

Underplaster extensions.

Raceway systems for limited use:

Flexible-metal conduit

Liquid-tight flexible-metal conduit

Underfloor raceway

Cellular-metal-floor or cellular-concrete-floor raceway

Wireways

Cable trays.

Special assemblies:

Busways

Cable bus

Multioutlet assemblies

Electrical floor assemblies.

In a branch circuit, the grounding conductor is colored green. When several grounding conductors are in one feeder raceway, one of the grounding conductors should be colored white or gray. The other grounded conductors should have a color stripe (but not green) over the white or gray, and a different color should be used for the stripe on each wire. For four-wire systems, the colors for underground conductors are usually blue, black, red, and white.

Galvanized rigid-steel conduit is used for branch circuits buried in the concrete slabs of multistory buildings.

Electrical metallic tubing is a thin-walled tube permitted by codes in locations where the raceway is not subject to physical damage.

Flexible metallic conduit, also known as Greenfield, is a continuous winding of interlocking metal stripping similar to that used for Type AC metal-clad cables (BX). These conduits are often used in short lengths at the terminal connection of a feeder to a motor. For wet locations, a watertight-type is available.

Surface raceways are usually oval-shaped and flat. When painted the same color as the wall or ceiling, they are less conspicuous than round-pipe conduit.

Two insulated conductors within a nonmetallic jacket, or within an extruded thermosplastic cover, may be used for surface extensions on walls or ceilings, or as an overhead cable with a supporting steel cable made part of the assembly. Extensions may be used in dry locations.

Busways carry bare conductors of rectangular cross section, which are assembled in a sheet-metal trough. The conductors are insulated from the

enclosure and each other. Busways must be exposed for heating dissipation. They are arranged with access opening for plug-in and trolley connections.

For heavy current loads, such as power service, several insulated cables may be mounted in parallel, at least one diameter apart, within a ventilated metal enclosure with access facilities. A cable bus costs less than bus bars for the same load but generally takes up more space. Use is limited to dry locations.

Underfloor raceways, or ducts, are placed under a new floor in an office space where desks and other equipment are frequently moved. Laid in parallel runs 6 to 8 feet apart, with separate ducts for power, signal, and telephone wires, these raceways may have flatplate outlet covers spaced 4 to 6 feet along each run. The alternative is feeder runs above the hung ceiling of the story below, with poke-through construction to reach new outlets above the floor. Underfloor raceways may be single-level or two-level. In steel frame buildings, with cellular-steel decking, single-level raceways may be included in the structure of the floor itself. A concrete header across the cellular runs provides the means of entering from the finished floor. A similar arrangement can be used in cellular precast-concrete decks, with metal-headers for connections. Wireways to carry large number of conductors carrying light-current signal- or control-circuits are available in fixed lengths. (See Functional Components section of Part 6 for more information on duct and cable accessibility.)

Panelboards

Panelboards are subsidiary distribution centers. Whereas service-switches have fuses, for high current-interrupting capacity, panelboards have circuit breakers or, for larger loads, fused knife-switches. Since a command center facility may have electronic equipment added in future expansion, panel boards should be oversized by two times, to accommodate new circuits.

A panelboard can have a single panel, or a group of panels assembled as a single panel. It has buses, switches, and automatic overcurrent protective devices for control of light, heat, or power circuits of small capacity. It is placed in a cabinet or cutout box, in or against a wall or partition, accessible only from the front. Panelboards are similar to switchboards, but are smaller.

Panelboards can be dead-front or live-front. In the dead-front type, no live parts are exposed when the door of the panelboard is open. In the live-front type, the current-carrying parts of the fuses or switches are exposed when the door of the panelboard is open. Dead-front panels are preferred.

Panelboards can be mounted flush, semiflush, or on the surface. Lighting systems require medium-load panels; some equipment may require heavy-load panels.

Distribution-panelboards distribute current to lighting-panelboards or power-panelboards.

Panelboards are designed with mains consisting of:

- Three-wire, single-phase 120/208-V, solid-neutral, direct-current.
- Three-wire 120/240-V, solid-neutral, direct-current.
- Four-wire, three phase, 120/208-V, solid-neutral, alternating-current.

The following items should be taken into consideration in determining the number and location of panelboards:

- No lighting panelboard should exceed 42 single-pole protective devices.
- A panelboard should be located as near as possible to the center of the load it supplies.
- Panelboards should always be accessible.
- Length of run from a panelboard to the first outlet should not exceed 100 ft.
- A panelboard should be located so that the feeder is as short as possible, and has a minimum number of bends and offsets.
- Spare circuit-capacity should be provided at the approximate rate of one spare to every five circuits originally installed.
- At least one lighting panelboard should be provided for each floor of a building.

Special Electrical System Conditions

The following items are particular conditions that may be relevant to command center electrical system components:

Communication Signal Protection

Auxiliary equipment such as air-conditioning, ventilating systems, and pumps containing motor drives are inherent transient-creators, particularly under starting conditions. This equipment should be electrically isolated from electronic equipment to the degree required to avoid adversely affecting the C-E equipment operation. In no case should the transient-producing, motor-driven equipment be served from the same distribution panel as sensitive C-E equipment.

Emergency Status

In emergencies, the C-E equipment requires full power. Task-lighting can be reduced to 65 percent of normal in operation areas; ambient lighting in other areas can be reduced to 20 fc. HVAC equipment must maintain the temperature in C-E equipment spaces within the limits of its operating range.

Power and Voltage

The following considerations should be given to special power and voltage control.

Direct-Current Power

Most equipment requires a +24 VDC supply rectified from single phase 50 to 60 hertz 115 VAC commercial source or supplied directly from an alternate energy source. The +24 VDC main supply is distributed throughout the equipment room and regulated down to proper device voltages in the equipment.

Foreign Power

Equipment and facilities to be operated in foreign countries must be designed with the power characteristics as required. If frequency conversion is required because of foreign power characteristics, a synchronous generator must be used. The input-requirements and output-capacity should be determined by the power available and the requirements of the equipment to be connected. Consideration should be given to standby requirements, and location of the frequency conversion equipment should be as close as feasible to the equipment being served.

400-Hertz Power

Electronic facilities often require that power be supplied at a frequency of 400 hertz. Two types of frequency-conversion equipment are available: motor generators and static converters. The type and capacity of the units should be determined by the equipment's requirements. Consideration should be given to standby-requirements when selecting and locating frequency-converters. Both types of converters must be grounded adequately to prevent electromagnetic interference. Power at 400 hertz requires conductors larger than those required for 60 hertz. To determine the proper wire-size, calculate the size of conductor required on either a d-c or a 60-hertz system. Then increase the size one EGG unit. All cables carrying 400-hertz power must be run in separate raceway systems.

FIRE PROTECTION AND LIFE SAFETY SYSTEMS

The fire protection and life safety systems provide command centers with the capability to reduce the risks of loss of life and property due to fire, smoke, toxic fumes, hostile threats, panic, and other hazards and emergencies. The level of protection required for fire protection and life safety can be determined by a site evaluation at the specific command center location—its unique design, spatial arrangement, construction, and operation. At a minimum, the design of fire protection and life safety systems should include:

- Identifying risks and hazards
- Establishing procedures for the reporting and abatement of risks and hazards
- Review procedures for new construction plans, and proposals for structural and occupancy modifications of existing facilities.
- Testing, inspecting, and maintaining:
  - Water supply systems
  - Fire hydrants
  - Notification and alarm systems

- Automatic detection and alarm systems
- Automatic fire suppression systems
- Standpipe systems
- Fire extinguishers

Fire protection system components that specifically relate to the command center personnel are:

- Smoke-control system
- Notification and alarm systems
- Detection and alarm systems
- Automatic fire-suppression systems
- Fire-extinguisher cabinets
- Standpipe systems.

Similarly, life safety system components that specifically relate to the command center personnel are:

- Means-of-egress
  - Occupant-load calculations
  - Exit-travel distances
  - Exit-unit widths for doors, corridors, and stairs
  - Exit signs
- Exit capacity
- Exit components
- Exit illumination
- Emergency lighting
- Smoke removal system
- Interior finishes.

Fire Protection System

Except as modified by waiver or by specific criteria from the military departments, fire protection shall conform to the requirements of applicable standards in the current National Fire Codes published by the NFPA. New command center facilities shall be fire-resistant or noncombustible construction separation from other areas by fire-rated walls or partitions. Existing command center facilities of combustible construction shall be replaced with noncombustible construction whenever practical.

Fire Detection System

All fire detection installations shall conform to the applicable provisions of NFPA Standards Nos. 72A, Local Protective Signaling Systems, 72D, Proprietary Protective Signaling systems, and 72E, Automatic Fire Detectors. Detection systems shall be arranged to alert building occupants of an alarm condition and to transmit a signal to a central alarm location or fire department. Where a station fire department does not exist, alarms shall be transmitted to a constantly attended location.

Detection systems are required for.

- All areas requiring detection systems by NFPA standards.
- Electronic equipment installations. A smoke-activated, automatic fire detection system shall be provided in electronic equipment rooms and in record storage rooms. Detectors shall transmit a signal to the fire department or central alarm location.
- Smoke detection systems shall be provided in underfloor spaces containing exposed nonmetallic sheathed cables. Fixed-temperature rate-compensated or fixed-temperature rate-of-rise heat detectors may be provided in underfloor spaces under circumstances when smoke detectors are not effective. Systems shall transmit a signal to the fire department or a central alarm location and shall activate underfloor Halon 1301 systems.

Heat-activated devices

Two main types of heat-activated devices are used as fire detectors: (1) the fixed-temperature type, designed to operate when the temperature reaches a predetermined value; and (2) the rate-of-rise type, designed to operate when the rapidity of temperature rise exceeds a predetermined rate (usually 15o to

25oF per minute) regardless of the temperature level. Some devices combine these two characteristics so that a fixed-temperature device operates in case the temperature rises too slowly to operate the rate-of-rise device.

The maximum spacing for satisfactory operation depends on the device's sensitivity, the ceiling construction, and the occupancy. For flat, smooth ceilings, the maximum satisfactory spacing between devices varies from 12-1/2 to 30 feet, depending on the particular device. The distance from a detector to the nearest wall or partition shall be one-half the distance between detectors. Closer spacing may be needed because of the type of construction in the protected area, possible drafts, heating systems, and other factors. For open-joist construction, spacing should not exceed 50 percent of the detector's smooth-ceiling spacing.

Products of combustion devices

Smoke-actuated devices are especially applicable to ducts of air-conditioning and ventilating systems, electronic computer systems installations, record vaults, and other areas of high value. Smoke-actuated detectors operate on a photoelectric principle or involve radioactive ionization.

Spot-type smoke detectors on a smooth ceiling with no air flow in the occupancy can be placed on 30-foot spacings or in such a way that they will cover 900 square feet. In rooms that have dominant air flow (for example, 20 air changes per hour) a maximum coverage of approximately 200 square feet per detector shall be used. Beam-type smoke detectors on smooth ceilings and with no forces air flow present can provide acceptable detection with the associated light beam for such equipment spaced up to 30 feet from the detector head.

Smoke detection systems shall be provided in electronic equipment areas, record and tape storage rooms, and other rooms that exit through the electronic equipment area. The detector shall transmit a signal to the fire department.

Smoke detection systems shall be provided in raised floor spaces containing exposed nonmetallic sheathed cables. Fixed-temperature, rate-compensated or fixed-temperature, rate-of-rise heat detectors may be provided in raised floor spaces when smoke detectors are not effective. Systems shall transmit a signal to the fire department.

Smoke detectors can be used to monitor air-conditioning and ventilation systems and to supervise the control of fans and ventilation dampers. It should be noted that smoke detectors designed for room protection cannot be used for these special purposes.

Smoke detectors should be used in any occupancy for which slowly developing, smoldering files are likely (for example, 20 air changes per hour) a maximum covered of approximately 200 square feet per detector shall be used. Beam-type smoke detectors on smooth ceilings and with no forced air flow present can provide acceptable detection with the associated light beam for such equipment spaced up to 30 feet from the detector head.

Fire Notification and Reporting System

Fire notification and reporting systems shall be installed in occupied areas and buildings as a means for automatically and manually reporting fires to station or base fire department headquarters or other central alarm location as required to implement fire fighting operations and emergency action. Such systems may be of either telegraphic, radio, or supervised conductor types. Extensions of fire reporting systems will require consideration of compatibility with existing equipment. Fire reporting systems shall not be provided at isolated small areas and similar restricted areas where personnel are not generally expected to be present.

These systems shall be designed in accordance with the requirements of: NFPA 70 National Electrical Code, Standard for the Installation, Maintenance and Use of Central Station Signaling Systems, NFPA 71; Standard for the Installation, Maintenance and Use of Local Protective Signaling Systems for Watchman, Fire Alarm and Signaling Service, NFPA 72A; Standard for the Installation, Maintenance and Use of Auxiliary Protection Signaling Systems for Fire Alarm Service, NFPA 72B; Standard for the Installation, Maintenance and Use of Remote Station Protection Signaling Systems, NFPA 72C; Standard for the Installation, Maintenance and Use of Propriety Protective Signaling Systems for Guard, Fire Alarm and Supervisory Service, NFPA 72D; Standard for Automatic Fire Detectors, NFPA 72E; Household Fire Warning Equipment, NFPA 74; and Public Fire Service Communications, NFPA 1221.

Fire alarm systems are classified as follows:

- Proprietary systems. Those in which the central station office is located within the property being protected. The systems are owned or leased by the protected property owner and operated entirely under that person's control. Details associated with this system are found in NFPA No. 72D, Proprietary Protective Signaling Systems.

- Auxiliary protection systems. Those protecting an individual building or group of buildings and using municipal fire alarm facilities to transmit a signal to the fire department. NFPA No. 72B, Auxiliary Protective Signaling Systems, provides requirements for this type of system.
- Remote-station systems. Those using a direct-circuit connection between signal-initiating devices at the protected property and signal-receiving equipment in a remote place such as a public fire station. These systems usually consist of a supervised local system connected by a leased, supervised telephone circuit to a constantly attended public fire station or other constantly attended remote station. This class of protective system is as effective as the auxiliary local current system and shall be used when cost estimates and reliability justify. Remote station systems shall comply with NFPA No. 72C, Remote Protective Signaling Systems.
- Central station systems. One or more signaling systems in which several signals are transmitted to a central equipment station. Facilities central station protection services shall insure that the system complies with NFPA No. 71, Central Station Protection Signaling Systems.
- Local protective systems. Those producing an alarm or supervisory signal only on the premises being protected. This system is not recommended for Army requirements, but may be required when alarm signals cannot be transmitted to a fire station. Under such circumstances, a qualified operator shall be present at the annunciator at all times. When used, such systems shall comply with the requirements of NFPA No. 72A, Local Protective Systems.

Automatic alarms

An automatic fire alarm reporting and receiving system receives coded fire, emergency, trouble, tamper, and system restore signals from detection/alarm and suppression systems. The system is generally located in the fire alarm or communication center and receives signals from the basic internal wire and telephone system, radio transmissions, or both.

Waterflow alarms respond to the water flow in a sprinkler system. They are mandatory wherever a sprinkler system is installed and shall comply with the sprinkler system water flow alarm and supervisory signal service articles of the NFPA Standards. One exterior, local, low-air-pressure alarm of the electric gong type shall be provided at each dry-pipe valve house to be actuated by a pressure switch. The electric circuits for the local water flow alarm and local low-pressure alarm can use the same exterior gong. An exterior, local, noncoded waterflow alarm of an approved design shall be provided for each underground supply connection. This is to operate continuously until manual clearing.

Automatic fire suppression systems

The following systems are installed in compliance with functional requirements in the following standards; Standard for the Installation of Carbon Dioxide Extinguishing Systems, NFPA 12; Standard for the Installation of Halon 1301 Extinguishing Systems, NFPA 12A; Standard for the Installation of a Halon 1211 Extinguishing Systems, NFPA 12B; Standard for the Installation of Sprinkler Systems, NFPA 13; Standard for the Installation of Foam Extinguishing Systems, NFPA 11; Standard for the Installation of Synthetic and Combined Agent Foam Systems, NFPA 11B; Standard for the Installation of High Expansion Foam Systems, NFPA 11A; Standard for the Installation of Foam-Water Sprinkler and Spray Systems, NFPA 16; Standard for the Installation of Standard Pipe and Hose Systems, NFPA 14; and the Standard for the Installation of Dry Chemical Extinguishing Systems, NFPA 17.

Automatic sprinkler systems

Properly engineered and installed automatic sprinkler systems are designed to detect the presence of fire, activate both local and remote (fire department) alarms and distribute water in sufficient quantity to either control or extinguish it.

The following factors shall be considered when determining the necessity and justification for automatic sprinkler installation in a given facility:

- Life safety and occupancy hazard risks
- Exterior fire exposures presented by the facility
- Strategic or tactical importance of the facility or supplies housed therein
- The quantity of supplies or facilities involved relative to available supplies or facilities of the same type
- The ability to replace the facility or its contents
- Inherent fire hazards of the facility
- Monetary value
- Size of the facility in relation to available fire fighting resources
- Permanency of the facility

Automatic sprinkler protection shall be provided in mission essential buildings.

Automatic sprinkler systems shall be provided in facilities or areas thereof to insure the maximum degree of life safety or property protection when the size, type of construction, occupancy, or other conditions create high monetary or severe strategic fire loss potential. This protection also shall be provided when the probability of fire severity is beyond local firefighting control or water supply.

Standard wet-pipe or preaction automatic sprinkler systems shall be provided in the following areas:

- Electronic equipment areas with combustible construction materials or where combustible materials are processed or stored including cards, paper, disks, and tapes inside machines.
- Areas containing major electronic training devices with combustible materials in the basic structure or as part of the simulator trainer.
- Combustible record storage rooms.
- Areas adjacent to the electronic equipment space. When economically advantageous, fire cutoffs with fire-resistant ratings equal to the rating provided for structural elements of the building can be provided in buildings of fire-resistive construction instead of sprinklers.
- Automatic power shutoff shall be connected to the detection system. This can be through an automatic memory safe cycle not to exceed 60 seconds.

The automatic sprinkler system shall be installed in compliance with the functional requirements criteria established in NFPA 13, Standard for the Installation of Sprinkler Systems.

Automatic Gaseous Extinguishing Systems

Halon 1301 total flooding systems may be provided in electronic equipment or areas where mission-essential functions are conducted and continued operation of equipment is essential to ongoing operations. However, Halon 1301 systems shall not be considered a substitute for required sprinkler protection.

Halon 1301 fire suppression systems can be installed in sprinklered or unsprinklered electronic equipment areas in which important military missions are conducted and continued operation is essential to the ongoing mission (for example, combat control centers, weapon control systems, critical communications facilities). These systems can also be provided for base-level ADPE business systems (for example, inventory control, data services) whose loss would impair administrative or other nonessential functions and would result in an economic loss but would not critically affect overall mission. MACOMs will establish the individual system's relative importance with respect to mission accomplishment and continuity. Depending on the project, this action may be coordinated with AF Communications Command and the responsible system project office (SPO).

Halon 1301 shall be provided for raised floor spaces containing exposed nonmetallic, sheathed cable. In electronic equipment installations that have an equipment replacement value of less than $500,000 and in raised floor areas less than 5000 cubic feet in volume, fixed automatic extinguishing systems can be omitted from the raised floor spaces, unless the electronic equipment is considered mission essential. System activation shall be by either cross zones or matrix detection. Activation of any single detector shall transmit a signal to the fire department and provide local audible or visual notification. Pickup by two or more detectors shall activate the Halon system, sound an audible or visual evacuation alarm, and transmit a signal to the fire department.

A system abort may be provided, but shall be a type that requires positive pressure on the switch until the system is reset.

In Type I or II structures (or a Type I or II addition to an existing structure), a Halon 1301 total flooding fire suppression system can be installed to protect electronic equipment. These systems are authorized in:

- Room(s) containing the electronic equipment.
- Any room with direct access to Halon-protected ADPE room(s) when the only exit from the room is through the Halon-protected room.
- Air plenums above or below the Halon-protected area.
- Space above or below the Halon-protected area.
- Space above or below the Halon-protected room, if the space or room contains combustibles; contains an opening to the Halon-protected area totaling more than 100 square inches; or contains electric cables not enclosed in conduit.
- Supply room or tape library.
- Room(s) adjacent to a Halon-protected area and housing high-value equipment that can be economically protected, considering the fire risks involved, with an extension of the Halon 1301 system.

Note: If the room has an opening into the Halon-protected area, as a minimum, it shall have a smoke detector(s) for alarm only. The space above the suspended ceiling in an electronic equipment area can be protected with smoke detectors; however, it shall have Halon protection if it is used as an air plenum or contains combustibles unless the ceiling system is 1-hour fire rated.

If the area is protected with Halon 1301, it shall have a forced ventilation exhaust system to the outside of the facility for smoke and Halon removal after the fire has been extinguished.

Halon 1301 systems shall not be considered a substitute for required sprinkler protection.

Halon 1301 is a colorless, odorless, electrically nonconductive gas that extinguishes fires by inhibiting the chemical reaction of fuel and oxygen. Persons can be exposed to Halon 1301 vapors in low concentrations for brief periods without serious risk. However, exposure to high concentrations for prolonged periods may produce dizziness, impaired coordination and disturbances in cardiac rhythm. Therefore, prompt evacuation of the premises is recommended.

The Halon 1301 system has the following characteristics:

- Automatic total flooding capability is supplied for each area.
- The system should be "zoned" with each area designated a specific zone. This is so Halon coverage is only applied to the zone requiring it.
- The system should be able to totally flood a zone with Halon in approximately 60 seconds.
- The Halon concentration applied to any zone should not exceed 5 percent design concentration by volume. The Halon weight requirements will be established based on mathematical formulas that consider the volume of the zone (area) to be covered and the specific volume of the superheated Halon 1301 vapor in accordance with NFPA Volume 1, Chapter 12A.
- Several combustion product (smoke) detectors (at least two per zone) should be spaced throughout each zone interconnected with the Halon system to activate the Halon system in the following ways.

If one detector activates in any one zone, TP and utility power to that zone should shut down automatically and an alarm will sound in the zone and at the base fire station. However, Halon protection should not be activated. In certain rooms, power will not be shut down unless more than one detector activates.

If more than one detector activates in any one zone, power to that zone will shut down, an alarm will sound, Halon activation should begin, and an alarm will sound at the base fire station.

- The system should have an uninterruptible power source in accordance with the NFPA.
- The Halon system should have a complete reserve supply manifolded into the system with a normally closed valve.
- The system should be able to be shut down manually to prevent damage or activation in the event of system malfunction or when it is apparent that the fire hazard condition does not require suppression by total flooding of Halon.
- All components used in this system should carry an Underwriter's Laboratory (UL) listing for fire protection.
- The system should be designed, built, and tested in accordance with the NFPA.
- The system design should include adequate provision for venting the zones covered by Halon to relieve the pressure buildup from releasing large quantities of Halon 1301. Venting design should be in accordance with the NFPA.
- Bilingual signs should be placed at all entrance doors to areas covered by Halon advising that these areas have Halon systems.
- Provide purge ventilation in the air-conditioning systems for areas protected by Halon systems. One complete air change in 10 minutes is recommended.
- All other areas should be protected by an automatic sprinkler system conforming to NFPA 13, NFPA 20, and AFM 88-15.

Portable fire extinguisher cabinets

Wall recessed (when space permits), flush-mounted recessed, or semirecessed extinguisher cabinets shall be provided for all new construction. Distribution is to be according to NFPA Standard No. 10. The type and size shall be approved by the local fire department. Normally, only water, water/AFFF, Halon 1211, dry chemical (ABC), or dry powder (D) will be permitted.

Windowless facilities or underground areas

These include, but are not limited to, facilities that are hardened, windowless, underground, and parts of facilities with the same properties (see Definitions).

For new construction:

- Automatic fire detection shall be provided.
- Facilities with combustible contents or Type III, IV, or V construction shall have an automatic sprinkler system.
- Facilities occupied by 100 persons or more (under normal or contingency conditions) shall be protected throughout by an automatic sprinkler system.
- Emergency lighting shall be provided in all areas.
- Standpipe outlets are required and shall be installed according to NFPA 14.

For existing construction:

- Automatic detection systems are required in all areas.
- Emergency lighting is required in all areas.

Life Safety System

Means of Egress

The occupant load is the total number of persons who may occupy command center facilities or parts of such facilities at any one time. The means of egress for all floors, balconies, tiers, or other occupied spaces shall have a capacity great enough for its occupant load.

Exit capacity shall be provided for at least the occupant load determined by dividing the gross area (area inside the exterior walls) of the facility by the occupant load factor for command center facilities. The occupant load factor shall be no less than one person per 100 square feet of gross floor area. (Based on "Business Occupancy," NFPA 101.)

The occupant load factor to determine exit requirements for various occupancy classifications are given in Figure 7-34.

Exit Capacity

Unit of exit width
1 unit - 22 inches
Fractions > 12 inches = 1/2 unit
Fractions > 12 inches are not counted.
Exit capacity per unit of exit component width
Doors: 1 unit per 100 persons
Stairs: 1 unit for 60 persons.

Means of egress components consist of three separate, distinct parts: the way of exit access, the exit, and the way of exit discharge. Each is illustrated in Figure 7-35.

Each facility shall have no less than two exits readily accessible at all times from every part of every floor. A single exit is allowed from a room or area if all the following conditions are met:

- Occupant load less than 100
- Direct access to a street or open exterior area at ground level
- Total travel distance no more than 100 feet from anywhere in a room to the outside
- No stairs in the exit travel more than 15 feet high
- All stairways completely enclosed with no door openings between the stair enclosure and rest of the building.

When more than one exit is required, at least two of the exits shall be separated and remote from each other and so arranged and constructed as to minimize any possibility of being blocked by fire or other emergency condition.

If two exits or two exit access doors are required in new construction, they shall be placed a distance apart equal to no less than one-half the length of the maximum overall diagonal dimension of the building or area to be served, measured in a straight line between exits.

Exit Travel Distance

Required exits shall be suitably located to allow access without passage through kitchens, storerooms, restrooms, workrooms, closets, bedrooms, or similar areas that may be locked.

Travel distances to exits shall be no more than 200 feet; they may be 300 feet if the facility is protected throughout by an automatic sprinkler system. Travel distance requirements apply to only the first, or nearest, exit from a point in a facility; this does not mean all exits shall be within the required travel distance. No dead-end corridor shall exceed 50 feet.

To measure the exit travel distance:

1. Start 1 foot from most remote point
2. Follow the centerline of the natural path of travel
3. Maintain 1 foot of clearance around corners and obstructions
4. Measure stairs in the travel path in the plane of the tread nosing
5. End at the center of the exit.

For individual rooms with an occupant load no greater than 6 persons, travel distance to exits shall be measured from the doors of such rooms, provided the path of travel from any point in the room to the room door does not exceed 50 feet.

Travel distance to exits for new and existing business occupancies shall be no more than 200 feet (60.96 meters).

An increase in the travel distance to 300 feet (91.44 meters) shall be permitted in a building protected throughout by an approved automatic sprinkler system.

Exit Components

Doors

The minimum clear width of a single door assembly is 32 inches.

The maximum single door leaf width in a doorway is 48 inches. The floor level shall be substantially level on each side of the door for a distance equal to the widest door. All doors used in a means of egress shall be the side-hinged, swinging type. Doors shall swing in the direction of exit travel:

1. When used in an exit
2. When serving in a high hazard area
3. When serving an occupant load of 50 or greater.

Projection of any door in a means of egress shall not reduce the effective width of an aisle, passageway, stair, or stair landing to less than one-half its required width. When fully open, the door shall project no more than 3-1/2 inches into the required width of a stair or stair landing and no more than 7 inches into the required width of an aisle or passageway.

The force required to fully open any door in the means of egress shall not exceed 50 pounds applied to the latch style.

Exit Marking

Exits shall be marked by signs. Access to exits shall be marked by signs when the exit or way to reach it is not immediately visible to occupants.

Any door, passage,or stairway that is neither an exit nor a way of access to an exit, shall be identified by a sign reading "Not an Exit," or by a sign indicating its actual designation such as "To Basement," "Storeroom," or so forth.

Every exit sign must:

- Have the word "EXIT" in legible letters at least 6 inches high with the principle strokes of the letters at least 3/4-inch wide.
- Be illuminated by a reliable light source no less than 5 footcandles on the illuminated surface when the building is occupied after dark or when it is not lighted by a natural source.

Exits and exit access when the exit or way to reach it is not immediately visible require an approved exit sign. The maximum distance is 100 feet from any point in the exit access to the nearest visible sign.

Exit Illumination

Means of egress shall be illuminated continuously during the time that occupancy conditions require an available exit. Artificial lighting shall be used

at such places and for periods of time required to maintain illumination to the minimum footcandle values specified in this chapter.

Floors in a means of egress shall be illuminated at all points,including angles and intersections of corridors and passageways, stairways, stair landings, and exit doors to values no less than 1.0 footcandle, measured at the floor.

All required illumination shall be arranged so that the failure of any single lighting unit, such as the burning out of an electric bulb, will not leave any area in darkness.

The same equipment or units installed to meet the requirements of Section 5-10 in reference (8) may also serve to illuminate the means of egress, provided that all applicable requirements of this section for such illumination are also met.

Sources of illumination

Illumination of means of egress shall be from a source of reasonably assured reliability, such as a public utility electric service. When electricity is used as the source, the installation shall be done properly in accordance with the National Electrical Code, NFPA 70.

Battery-operated electric lights and any type of portable lamp or lantern shall not be used for primary illumination of the means of egress, but may be used as an emergency source to the extent permitted under "Emergency lighting."

No luminescent, fluorescent, or reflective material shall be permitted as a substitute for any of the required illumination specified here.

Exit lighting and exit signs shall conform to NFPA 101. Exits, exterior steps, and ramps shall be lighted well enough to prevent accidents. Separate lighting need not be provided if street or other permanent lighting gives at least 1 footcandle at the exit, steps, or ramp.

Emergency Lighting

Emergency lighting shall be required when:

1. The building is two or more stories high above the level of exit discharge.

2. The occupant load is 100 or greater above or below the level of exit discharge

3. The occupant load is 1000 or more.

When maintenance of illumination depends on changing from one energy source to another, there shall be no appreciable interruption of light during the changeover. When emergency lighting is provided by a prime mover-operated electric generator, no delay more than 10 seconds shall be permitted.

System Performance

Emergency lighting shall be arranged to maintain the specified degree of illumination for 1-1/2 hours in the event of normal lighting failure.

Electric battery-operated emergency lights shall use only reliable types of storage batteries provided with suitable facilities for maintenance in properly charged condition. Dry batteries shall not be used to satisfy these requirements. Electric storage batteries used in such lights or units shall be approved for their intended use and shall comply with the National Electric Code, NFPA 70.

An emergency lighting system shall be arranged to provide the required illumination automatically in the event of normal lighting interruption, such as any failure of the public utility or other outside electrical power supply, opening of a circuit breaker or fuse, or manual act(s), including accidental opening of a switch controlling normal lighting facilities.

An emergency lighting system shall have either continuous operation or shall be capable of repeated automatic operation without manual intervention.

Emergency lighting systems shall be provided in accordance with the requirements of NFPA 101. In facilities with standby electric power systems, provisions shall be made to transfer the exit lighting system to the standby generating source. Emergency supplementary incandescent lighting of 2 footcandles shall be provided along aisles and walkways in high bay areas where high intensity discharge lighting is used. In buildings with large electrical loads, full consideration shall be given to the possible economy of using higher voltages or frequencies for the lighting system.

When the occupancy requires emergency lighting, all exit signs shall be illuminated by the emergency lighting system. An exception is if self-luminous signs are used.

For exit marking,directional signs are those with an arrow and are used when the direction to the nearest exit is not readily apparent.

Occupancy Types	Square Feet Per Person
Assembly	
Concentrated use (auditorium)	7 (net area)
Less concentrated (conference, dining)	15 (net area)
Standing or waiting space	3 (net area)
Bench seating	18" per person
Classrooms	20 (net area)
Shops	50 (net area)
Office areas	100 (gross)
Storage/shipping areas	300 (gross)

Figure 7-34. Occupant Load for Determining Exit Requirements

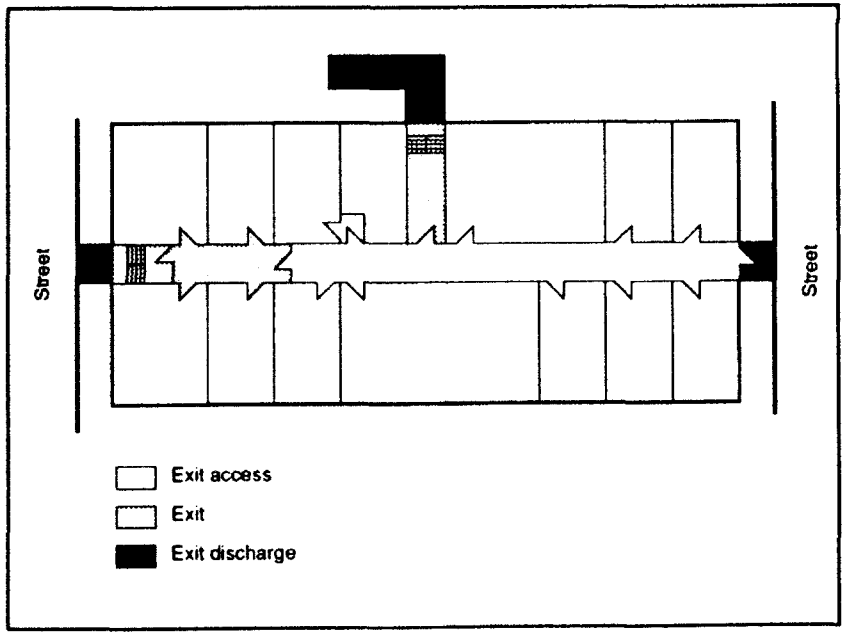


Figure 7-35. Means of Egress

Special signs are required for exit marking when doors, passages, and stairways are likely to be mistaken for exits. These signs shall read "NOT AN EXIT."

Smoke Removal System

These systems are essential in windowless and multistory buildings to avoid undue exposure of occupants to and permit firefighting. However, economic considerations may preclude the provision of separate exhaust systems. Design features of combined ventilation and smoke removal systems include:

- Separate fan and duct systems for each floor in multistory buildings and for each fire areas in windowless and multistory buildings.
- Dampers and ducts for direct discharge to outside from each return air system.
- Separate manual control, readily accessible for fire department use, for all supply and return fans and dampers controlling discharge to the outside. Automatic operation of smoke removal system by smoke detectors or by the fire alarm shall be provided when feasible.

Effective use of air-handling systems for smoke removal involves the following principles:

- Development of negative pressures in the fire or smoke area by shutdown of air supply fans and diversion of return air directly to outside.
- Development of positive pressures in the adjacent areas by shutdown of return air fans.

If the area is protected with Halon 1301, it shall have a forced ventilation exhaust system to the facility exterior for smoke and Halon removal after the fire has been extinguished.

Air-handling systems including ducts can potentially spread fire, smoke, and hot gaseous products of combustion through the building or areas they serve. This hazard shall be minimized by providing suitable fire doors or fire dampers where ducts pass through fire walls or fire partitions and by providing protection where ducts pass between floors vertically.

Ceiling plenums introduce a serious smoke and fire spread potential. Plenums may be used as an integral part of an air-handling system only if they

conform to the requirements of the NFPA No. 90A, Air-Conditioning and Ventilation Systems. Under no circumstances may combustible materials be located within the air plenum space. All electrical wiring passing through the space, including that for telephone and communications, shall be in metal conduit unless an automatic extinguishing system is provided.

Interior Finishes

An interior finish is defined as the material of walls, ceilings, wainscotting, and other inside surfaces of a building. It includes other interior surfacing materials applied to the walls, movable partitions, and ceilings. Exposed insulation and acoustical materials are considered interior finishes; these, along with structural fire resistance and contents hazard, are the main elements in determining building fire potential.

Wall and ceiling finishes and movable partitions for new construction, alterations, and rehabilitation shall conform to requirements of the Life Safety Code, NFPA No. 101, (1) except as follows:

- Interior finish for all exits shall be Class A only. Interior finish for all other areas shall also be Class A. The use of Class B, C, D, and E materials is not permitted. Smoke developed ratings by Standard Test Method for Surface Burning Characteristics of Building Materials ASTM E-84 test shall not exceed 50 for Class A materials and 100 for Class B materials. Cellular plastics shall not be used as interior finish materials.

In the case of existing construction with combustible interior finish, certain basic safeguards are essential. Several alternate measures are available to provide the necessary safeguards for the protection of both life and property against fire as follows:

- Cover combustible surfaces with gypsum board or other materials meeting the requirements for new construction, or
- Protect the building with an automatic sprinkler system, or
- Coat all exposed combustible surfaces with an Underwriters listed fire retardant paint or coating.

Basic Flammability Requirements for carpet systems (carpeting and underlay combined) for Federal law requires that all carpet manufactured for sale shall comply with 16 Code of Federal Regulations (CFR) Part 1630 (DOC FF 1-70) Standard for the Surface Flammability of Carpets and Rugs.

Carpet systems for corridors shall meet specific acceptance criteria specified below when tested in accordance with Federal Test Method Standard 372 or Underwriters' Laboratories chamber Test, UL 992. For this purpose, a corridor is defined as an enclosed space connecting a room or compartment with an exit and may include normal extensions such as lobbies and other enlarged areas. The flame propagation index of less than 4.0 as determined by UL Chamber test, UL 992, is acceptable for corridor systems in all facilities. The minimum acceptance criteria (average critical radiant flux) as determined by Federal Test Method Standard 372 for corridor carpet systems shall be 0.25 watts per square centimeter for carpet systems in corridors of all other facilities and in electronic equipment areas.

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LIST OF ACRONYMS

ADCCP	Advanced data communications control procedure
AIOD	Automatic identification of outward dialing
AMH	Automated message handling
AMHS	Automated message handling system
ANSI	American National Standards Institute
AO	Action officer
APP	Applications portability profile
ARS	Advanced record system
AUTODIN	Automatic Digital Network
BDS	Briefing and display subsystem
BISDN	Broadband ISDN
BKE	Block error
BPS	Bit per second
BRI	Basic rate interface
C-E	Communications-electronics
C3	Command, control and communications
C3I	Command, control, communications, and intelligence
CCIP	Command Center Initiatives Program
CCIR	International Radio Consultative Committee
CCITT	International Telegraph and Telephone Consultative Committee
CCS	Command and control system
CCTV	Closed circuit television
CMW	Compartmented mode workstation
CNN	Cable News Network
CODEC	Coder-decoder
COMSEC	Communications security
CPU	Central processing unit
CSMA	Carrier sense multiple access
DA	Distribution amplifier
DAM	Device adaptor module
DBMS	Database management system
DCE	Data circuit-terminating equipment
DCTN	Defense Commercial Telecommunications Network
DDN	Defense Data Network
DIA	Defense Intelligence Agency
DID	Display interface device
DISA	Defense Information Systems Agency
DoD	Department of Defense
DTE	Data terminal equipment
DTS	Data transmission subsystem
DVE	Digital video effects
EAC	Emergency action console
EAM	Emergency action message

ECSA	Exchange Carriers Standards Association
EIA	Electronics Industry Association
EMP	Electromagnetic pulse
FCC	Federal Communication Commission
FDA	Food and Drug Administration
FDDI	Fiber distributed data interface
FDM	Frequency division multiplexing
FTS	Federal Telephone System
FY	Fiscal year
GOSIP	Government Open Systems Interconnection Profile
GSA	Government Services Administration
HDLC	High-level data link control
HEMP	High-altitude electromagnetic pulse
HVAC	Heating, ventilating, and air conditioning
IEEE	Institute for Electrical and Electronics Engineers
IMA	Interactive Multimedia Association
IPS	Information processing subsystem
IR	Infrared
ISDN	Integrated Services Digital Network
ISO	International Standardization Organization
ITU	International Telecommunication Union
IU	Initial user
JPEG	Joint Photographic Experts Group
JTC3A	Joint Tactical Command, Control and Communications Agency
KBPS	Kilobits per second
KSU	Key service unit
KTU	Key telephone unit
LAN	Local area network
LSWD	Large screen wall display
MBPS	Megabits per second
MIM	Metal-insulator-metal
MIPS	Millions of instructions per second
MLS	Multilevel security
MOE	Magneto-optical (erasable)
MPEG	Motion Picture Experts Group
MROC	Multi-command required operational concept
NCS	National Communication System
NDI	Non-de· ' ₚmental item
NIST	National Institute for Standards and Technology
NSA	National Security Agency
OCR	Optical character recognition
OSI	Open systems interconnection
OPSEC	Operational security
PAL	Phase alternate line
PBX	Private branch exchange
PCU	Premises control unit
POSIX	Portable operating system interface fo· computer environments
POTS	Plain Old Telephone Service

PRI	Primary rate interface
PSN	Packet switching node
PSTN	Public Switched Telephone Network
PTT	Postal telegraph and telephone
PZM	Pressure zone microphone
RBOC	Regional Bell operating company
RF	Radio frequency
RGB	Red, green, blue
RGB+S	Red, green, blue, plus synchronization
RISC	Reduced instruction set computing
SCI	Special compartmented information
SCIF	Special compartmented information facility
SDNS	Software defined network system
SECAM	Sequential Couleur avec memorie (Sequential color with memory)
SMDR	Station message detail recording
SNR	Signal to noise ratio
SPL	Sound pressure level
STU-III	Secure telephone unit-III
TCP/IP	Transmission control protocol/internet protocol
TDM	Time division multiplexer
TS/SBI	Top secret/special background investigation
UIMS	User interface management system
VCD	Video connection device
VCR	Video cassette recorder
VDT	Video display terminal
VGA	Video graphics adapter
VTC	Video teleconferencing
VTR	Video tape recorder
WAN	Wide area network
WATS	Wide area telecommunications service
WIN	WWMMCS Intercomputer Network

GLOSSARY

Accuracy. The probability that the information in a database is free of mistakes and errors.

ADA. The higher order computer programming language required by the DoD.

Algorithm. A set of well-defined rules for the solution of a problem in a finite number of steps.

Analog. Used to describe a physical quantity, such as voltage, that varies in a continuous manner.

Analog-to-digital converter. A device which translates continuous analog signals into proportional discrete digital signals.

Annotation. Placing text, icons, or symbols such as arrows over a map, graphic, or video image.

Anthropometry. The study of human body measurement, especially on a comparative basis.

Application. A software product or class of software products that perform a definable task, such as word processing, character recognition, etc.

Architecture. The arrangement of the basic elements of a system into an orderly framework describing structure, functions, features, and binding technical and engineering constraints on the system.

Asynchronous. A data transmission mode that requires timing information to be included in each character in the form of start and stop bits.

Attenuation. Decrease in intensity of a signal, beam, or wave as a result of absorption of energy and of scattering out of the path of a detector.

Audio conferencing. A function that permits groups of people meeting in separate conference rooms and major cells to communicate at the group level.

Audio intercom. A function that connects briefers at conference room lecterns with audiovisual technicians in a technical control facility for private conversations.

Audio monitoring. A function that permits audiovisual technicians, who control and coordinate conference room briefing images, to monitor conference room activity from a technical control facility.

Audio paging. An audio function that permits telephone users to make voice announcements throughout the command center.

Automatic message handling system. Any organized assembly of resources and methods used to collect, process, and distribute messages by automatic means.

Availability. The probability that a system's functional capabilities are ready for use at any given time where all time is considered, including operations, repair, administration, and logistics time.

Backlighting. Illumination from behind used to improve the clarity of a display. Usually used with liquid crystal displays.

Baud. A unit of signaling speed equal to the number of code elements per second.

Bandwidth. A range within a band of frequencies.

Biomechanics. The mechanics of biological and muscular activity.

Blooming. The mushrooming of an electron beam (with consequent defocusing) produced by too high a setting of the brightness control.

Briefing display subsystem. A subsystem of the command center system architecture that encompasses graphics workstations, video switches and controller, large screen displays and monitors, video teleconferencing mechanisms, and other audiovisual support equipment. It has connectivity to the backbone network and can provide a path for obtaining digitized graphics developed on information processing workstations.

CRT projection. Direct or reflected projection of a cathode ray tube image.

Capacity. The quantity of information that can be processed successfully by a system, sometimes defined in terms of throughput or the rate at which the system can perform its tasks.

Circuit. 1) An electronic path between 2 or more points, capable of providing a number of channels. 2) A number of conductors connected together for the purpose of carrying an electrical current.

Client. A network resource that requests the support of another resource.

Client/server. A partnership between two or more cooperative processes supporting a common set of services. Two interpretations of this client/server model are X-Windows and non X-Windows environments, differing in the interpretation of clients and servers.

Closed circuit television. A TV system in which the transmission of the TV signal is limited to only those receivers that are physically connected to the system.

Code security. Methods to minimize the risk of inadvertent disclosure of memorized access control codes.

Command center. A facility from which a commander and his representatives direct operations and control forces. It is organized to gather, process, analyze, display, and disseminate planning and operational data, and perform other related tasks.

Command and control. The exercise of authority and direction by a properly designated commander over assigned forces in the accomplishment of the mission. Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission.

Command and control system. The facilities, equipment, communications, procedures, and personnel essential to a commander for planning, directing, and controlling operations of assigned forces pursuant to the missions assigned.

Commonality. The capacity for subsystem components within any one command center, or among two or more command centers, to interoperate.

Common user network. A system of circuits or channels allocated to furnish communication paths between switching centers to provide communication service on a common basis to all connected stations or subscribers. It is sometimes described as a general purpose network.

Communications security. Protective measures to ensure the continuity and integrity of information being communicated, as well as the security of the transmission medium. The protection ensures the authenticity of telecommunications and results from the application of measures taken to deny unauthorized persons information of value which might be derived from the acquisition of telecommunications (e.g., encryption and authentication).

Communications subsystem. The subsystem within the command center system architecture that is made up of the hardware, software, and protocols required to interconnect equipment within the command center and to terminate external communications facilities appearing in the command center.

Composite video. A video transmission in which the picture information in analog form is sent on the same cable with the blanking and synchronizing signals. The composite video may also include a subcarrier modulated with chrominance information.

Computer security. Measures taken in computer systems to deny access by unauthorized users.

Configuration management. Identification of all logical and physical network resources, collection of data from all network resources, and analysis of all changes.

Credibility. The ability to provide information that is worthy of belief or trust. This includes such characteristics as accuracy and timeliness.

Current architecture. An architecture to be achieved in the near term, and usually having less than optimal characteristics.

Data security. All measures established to ensure the availability and integrity of data. The protection of data within a computer environment from accidental, unauthorized intentional, or malicious modification, destruction, or disclosure by such means as passwords, encryption, and file partitioning.

Defense readiness condition. A uniform system of progressive alert postures for use between the Joint Chiefs of Staff and the commanders of the unified and specified commands and for use by the Services. Defense Readiness Conditions are graduated to match situations of varying military severity (status of alert). Defense Readiness Conditions are identified by the short title DEFCON 5, 4, 3, 2, and 1.

Demodulate. To recover the modulating wave from a modulated carrier.

Electronic publishing (or desktop publishing). An advancement beyond word processing offering a higher level of integration of words/text and graphics/images. Can perform all traditional typesetting tasks.

Diffuse. To spread out; not concentrated or localized.

Digital. Of or relating to data in the form of numerical digits.

Digital circuitry. Circuitry pertaining to data in the form of pulses of discrete duration, amplitude, etc.

Digital communications. System of telecommunications employing a discontinuous signal that changes in frequency, amplitude, or polarity.

Display aspect ratio. Ratio of display width to height.

Display brightness uniformity. Ratio of brightness at center to brightness at edge of display.

Display contrast ratio. Ratio of darkfield to whitefield.

Display resolution. Measure of picture detail.

Display technique. Method by which an image is formed. Three types: Raster scan: a predetermined pattern of scanning lines that provides uniform coverage of screen; Vector scan: random direction of light energy to a specific point on a screen; Matrix addressing: method for directing electrical energy to a specific element in an active display.

Duplex. In data communications, pertaining to a simultaneous two-way independent transmission in both directions.

Electroluminescent display. Flat plate display which excites phosphorescent pixels as a light source.

Electromagnetic pulse. The electromagnetic radiation from a nuclear explosion caused by Compton-recoil electrons and photoelectrons from photons scattered in the materials of the nuclear device or in a surrounding medium. The resulting electric and magnetic fields may couple with electrical/electronic systems to produce damaging current and voltage surges. May also be caused by nonnuclear means.

Electronic security. The protection resulting from all measures designed to deny unauthorized persons information of value that might be derived from their interception and study of noncommunications electromagnetic radiations, e.g., radar. (JCSI-DoD) (JCSI-IADB)

Emanation security. Protection that results from all measures designed to deny any unauthorized persons information of value that might be derived from interception and analysis of compromising (electro-magnetic) emanations from other than crypto-equipment and telecommunications systems (e.g., TEMPEST controls).

Emission security. That component of communications security which results from all measures designed to deny unauthorized persons information of value which may be derived from interception and analysis of compromising emanations for crypto-equipment and telecommunications systems.

Emulate. To imitate one system with another, primarily by hardware, so that the imitating system accepts the same data, executes the same computer programs, and achieves the same results as the imitated system.

Encryption. The coding of a clear text message by a transmitting unit so as to prevent unauthorized eavesdropping along the transmission line; the receiving unit uses the same algorithm as the transmitting unit to decode the incoming message.

Ergonomics. The study of human capability and psychology in relation to the working environment and the equipment operated by the worker.

Facilities subsystem. The subsystem of a command center system that provides the essential shelter and support elements to promote interaction among command center personnel.

Facsimile. A device which electronically transmits information written or printed on paper, generally used to convey images (facsimiles) of typewritten forms, printed figures, or hand-drawn diagrams to other sites.

Fault management. Detection, isolation, and correction of abnormal operation through maintenance of error and traffic logs, trace, isolation and corrective procedures.

FDDI. A high-speed fiber optic network; Fiber Distributed Data Interface

Flexibility. The ability to adjust rapidly to change.

Frequency hopping. A spread spectrum modulation technique which turns a signal into a moving target making it difficult but not impossible to jam.

Government Open Systems Interconnection Protocol. A set of computer system standards based on the seven-layer ISO OSI reference model developed by the Federal Government.

Human-factors engineering. The area of knowledge dealing with the capabilities and limitations of human performance in relations to design of machines, jobs, and other aspects of the human's physical environment.

Information processing subsystem. A subsystem of a command center system with functionality that is expected to be distributed to the extent permissible within security constraints. Local area networks exist in the individual command center work spaces and user workstations have access to all user functionality.

Intelligibility. That quality of information that renders it clear, comprehensive, and understandable.

Interoperability. The ability of systems to provide services to and accept services from other systems and to use the services so exchanged to enable them to operate effectively together. The condition achieved among communications-electronics systems or items of communications-electronics equipment when information or services can be exchanged directly and satisfactorily between them and with their users.

ISDN. A technology for a future digital telecommunications network consisting of a layered set of protocols supporting new services compatible with the 64 Kbps of today's digital telephony.

Interface unit. The electronic component used to interface two or more networks together; includes bridges, routers, gateways, bus interface units, network interface units.

Light valve. Switched or modulated light beam. Three types: oil film, solid state, liquid crystal.

Local area network. A system linking together computers, word processors and other electronic office machines to create an inter-office or intersite network.

Maintainability. The ratio of system maintenance time to operating time. It may be stated numerically in such terms as mean-time-to-repair, maintenance man-hours per operational hour, mean and maximum downtime, etc.

Mean time between failure. The average length of time that the system or component will continue to operate satisfactorily without failure.

Megabyte. One million bytes of information (8 million bits).

Modular. Constructed with standardized units or dimensions for flexibility and variety in use.

Modularity. The degree to which system components could be separated into functional and equipment "building blocks."

Modulate. To vary the amplitude, frequency, or phase of a carrier wave or a light wave for the transmission of information as by radio.

Monochrome. One specific color (frequency) of optical radiation.

Multimedia. The integration into one interactive electronic product of a combination of text, graphics, sound, and still or motion video.

Multilevel security. A mode of operation that allows two or more classification levels of information to be processed simultaneously within the same system when not all users have a clearance or formal access approval for all data handled by the automated information system.

National command authority. Consists only of the President and the Secretary of Defense or their duly deputized alternates or successors.

National Military Command System. The NMCS is the priority component of the WWMCCS designed to support the NCA in the exercise of their responsibilities. It also supports the JCS in the exercise of their responsibilities.

Office automation. The performance by electronic systems of formerly manual or mechanical information generation, storage, and manipulation tasks.

Operating system. The nucleus of a computer system. It is the layer of software that orchestrates a varied set of hardware and software components through which program requests for services are directed.

Operations security. Conformance with specified operating doctrine to preclude enemy acquisition of useful, sensitive information.

Optical character recognition. A capability possessed by software applications to interpret scanned images as text and create an editable version of the text-image file.

PAL. European color television standard: 625 lines/frame, 25 frames/second.

Packet transmission. Transmission of standardized packets of data by networks of high-speed switching computers.

Performance management. The determination of network availability and throughput based on accounting and configuration management data.

Phosphor dots. Elements of a cathode ray tube that glow red, green, or blue.

Pixel. A contraction of the words picture element. Usually used to mean a discrete sample taken from a video signal, as when A/D conversion is being performed. Also may mean a discrete element or "dot" on a CRT or other display device or an element of a computer graphic bitmap.

Plasma display. Flat plate display which uses an ionized gas to convert electrical energy to light.

Platform. A shared network resource computer system capable of being configured.

Plenum. The area between a base floor and raised floor, or between a ceiling and a lower suspended ceiling.

Plug and play. A capability in an open system in which computer resources cooperate through use of defined standards.

Projection. Distance for viewable image quality.

Projection size. Size of the projected image, expressed typically in length x width, or diagonal, measure.

Protocol. A set of hardware and software interfaces in a terminal or computer which allows it to transmit over a communications network, and which collectively forms a communications language.

Prototype. A model suitable for use in complete evaluation of form, design, performance, and production potential.

Red-Green-Blue. Commonly known as RGB, a system of color video transmission in which each additive primary color is assigned a separate circuit. Synchronizing and blanking signals may be sent on a fourth separate circuit, or may be combined with the green signal.

Raster scan. A technique of generating or recording a display image by a line by-line sweep across the entire display space; for example, the generation of a picture on a television screen.

Redundancy. Any deliberate duplication or partial duplication of circuitry or information to decrease the probability of a system failure.

Reliability. The probability that a system will perform satisfactorily for a given period under stated conditions.

Responsiveness. The ability to react to requirements within established time criteria.

Retrofit. To furnish with new parts or equipment not available at the time of manufacture.

Reverberation. An effect or impact that resembles an echo.

Routing. The assigning and establishing of a path for transmitting information between stations in a communication network.

Ruggedize. To strengthen for better resistance to wear, stress, and abuse.

SECAM. French, USSR color television standard: 625 lines/frame, 25 frames/second.

Security management. The ability to control and distribute data to various open architecture network resources.

Sensitive compartmented information. Classified information about or derived from intelligence sources, methods, or analytical processes that is required to be handled exclusively within formal access control systems established by the Director, Central Intelligence Agency.

Server. A computer resource responding to and providing the support service requested by the client.

Software security. Measures incorporated within the logic of the coded instructions which constitute operating system, utility, or applications software to protect the data processed and the system itself.

Specified command. A command that has a broad continuing mission and is established and so designated by the President through the Secretary of Defense with the advice and assistance of the Joint Chiefs of Staff. It normally is composed of forces from but one Service.

Stovepipe systems. Systems that provide a complete pathway from end to end, generally without any suitable, ready-made interfaces to connect with other systems.

Survivability. The ability to continue to exist and function satisfactorily after, or in spite of, nuclear conflict, conventional conflict, hostile countermeasures, sabotage, or natural disaster.

Synchronous. Occurring with a regular or predictable time relationship.

Technical assessment/cost estimate. A document developed by a command to present technical alternatives for upgrades to C^3 systems and the costs associated with each.

Target architecture. An architecture definition stated for some point in the future with which any interim architecture must be consistent, and toward which any interim architecture must be upgradeable.

Teleconferencing. A conference between two or more persons remote from one another but linked by a telecommunications system.

Terminal. A computer peripheral device, local or remote, hard copy or electronic, providing basic input and output capabilities, having very limited intelligence, stored programs, and data storage.

Topology. The physical or logical placement of nodes in a computer network.

Trunk circuit. A circuit between two telephone exchanges for making connections between subscribers.

Unified command. A command with a broad continuing mission under a single commander and composed of significant assigned components of two or more Services, which is established and so designated by the President, through the Secretary of Defense with the advice and assistance of the Joint Chiefs of Staff; or, when so authorized by the Joint Chiefs of Staff, by a commander of an existing unified command established by the President.

Usability. The ability to satisfy a defined need in a clear, comprehensive, and readily operable way from a human viewpoint. It includes ease of use, as well as management, operator, and user acceptability.

User interface. An application layered above the operating system of a workstation that makes the OS easier to use.

User processing support. The physical and technical ability to provide command center users with reliable access to data for decision making.

User-system interface. A man-machine interface, a human interface that has proven to be crucial in user acceptance and use of software systems.

Validity check. Computer check of input data, based on known limits for variables in given fields.

Vector scan. A computer graphics technique in which points define lines and curves.

Video teleconferencing. An electronic communication across distance that includes both images and sound.

Visual display terminal. The part of a computer or word processor on which text or diagrams are displayed.

Wideband. Of, having, or involving operations with uniform efficiency over a wide band of frequencies.

Word processing. A low level of word/text and image/graphics integration; focuses on sophisticated manipulation of words, sentences, paragraphs, pages, and documents.

Workstation. A computer system used by one user that is capable of being configured.

Work-station. An area that contains the basic equipment required by an individual performing routine tasks.

X Windows. Public domain network-based graphics windowing system supported by major computer vendors.

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CCDH READER RESPONSE QUESTIONNAIRE

This edition of the CCDH marks the first revision of the document to be distributed to users since the publication of the Pilot edition in 1987. DISA has invested significant effort to make this edition fulfill the needs of its intended readership, the user community in the command centers of the NMCS and the unified, specified, component, and subordinate commands. DISA has also become committed to supplying readers with regular updates, and has developed a format designed to support their production and inclusion. It is up to the user community to evaluate these efforts and either validate them or help to determine how they should be redirected.

This for-comment edition of the CCDH is not perfect nor complete. Some of the elements in it are included on a trial basis; reaction from the field will determine whether they are useful and ought to be continued. However, the document's intended structure is evident, accurate information has been supplied wherever possible, and in each section at least a portion of the intended text is presented to enable readers to comment on the concept being proposed. In the anticipation of candid and detailed comments from the field, DISA is planning to issue a complete revision of the CCDH in March 1992. The format and structure of that edition will be developed in direct response to reader's comments, and will become the model for the yearly reissue of and periodic supplements to the document.

This multiple-choice questionnaire will take approximately 15 minutes to complete. In addition to answering the questions, you are encouraged to make additional observations about anything you consider pertinent. Two copies of the questionnaire follow this page. Please ask everyone who uses or reviews the CCDH to complete the questionnaire, making extra copies if necessary. When finished, fold the questionnaire(s) in half, staple, stamp, and mail; the address is printed on the reverse of the last page. Even if you have not finished reading the document, your comments are desired. Please return your comments by 10 November 1991.

Thank you for your participation!

A. OVERALL IMPRESSION

1. What is your overall impression of the usefulness to you of the CCDH in concept, based on the example you've reviewed?

___ very useful
___ somewhat useful
___ possibly useful
___ not very useful
___ not useful at all

2. How would you characterize the technical quality of the CCDH?

___ good
___ overall good, but some bad parts
___ mediocre
___ overall bad, but some good parts
___ bad

3. How would you characterize the readability and ease of use of the handbook?

___ good
___ overall good, but some bad parts
___ mediocre
___ overall bad, but some good parts
___ bad

4. Please focus in on the major parts of the document. For each one, indicate your general impression. Feel free to add comments.

	Liked	Didn't like	No opinion	Didn't review	Comments
Vol. 1:					
Part 1: Command Center Improvement					
Part 2: Command Center Improvement Process					
Part 3: Current Command Center Reference Works					
Part 4: Improvement Process Examples					
Vol. 2:					
Part 1: Introduction					
Part 2: Command Center Core Spaces					
Part 3: *Command Center Support Spaces*					

Vol. 3:	Liked	Didn't like	No opinion	Didn't review	Comments
Part 1: Introduction					
Part 2: Command Center System Architecture					
Part 3: Communications					
Part 4: Information Processing					
Part 5: Briefing and Display					
Part 6: "Stovepipe" Systems					
Part 7: Facilities					
"Yellow Pages" following Parts 3 and 4					
All Volumes:					
Glossary					
Index					

B. CONTENT

1. How appropriate to your needs was the selection of topics covered in the CCDH (regardless of the data provided for each topic)?

___ very appropriate ___ adequately appropriate ___ not very appropriate

2. In your opinion, was emphasis placed on the right topics? Please note any areas you feel received too much or too little discussion.

___ appropriate emphasis
too much emphasis on _____
too little emphasis on _____

3. How appropriate to your needs was the level of detail presented for each topic?

___ very appropriate ___ adequately appropriate ___ not very appropriate

4. How appropriate was the level of technical knowledge required of the reader?

___ too advanced ___ appropriate ___ too basic

5. Please think over the parts of the CCDH you have reviewed and note if any sections stood out as particularly good or bad in terms of content. You may cite page numbers or sections, and consider the issues raised in questions 1-3 as well as accuracy, completeness, opinion vs. fact, etc.

C. STRUCTURE

1. How well did you feel the CCDH was defined and coordinated as a whole?

___ very well ___ adequately ___ not very well

2. How easily did you develop a sense of the CCDH's structure and an idea of where to find specific information?

___ very easily
___ easily
___ with reasonable effort
___ with significant effort
___ have not yet succeeded in doing so

3. Did any part of the text seem not to fit with the rest of the handbook? Please specify.

4. Did anything appear to be lacking? Please specify.

D. FORMAT/READABILITY

1. How much of the CCDH did you read?

___ a few pages
___ 1/4
___ 1/2
___ most
___ all

2. How did you read the CCDH?

___ looked for and read specific passages only
___ skimmed over it
___ read carefully as much as possible
___ combination of these methods

3. How well did the CCDH support this method of reading?

___ very well ___ adequately ___ not very well

4. With regard to the different page layouts used for different sections, was it clear why a certain layout was used for a particular kind of information?

___ yes ___ sometimes ___ no

5. Did you have any problem adjusting to different page layouts?

___ yes ___ sometimes ___ no

6. Please record your impressions of the format/physical presentation of the CCDH.

	Liked	Didn't like	No opinion	Comments
Type size				
Horizontal orientation				
Narrative page design: Vols. 1 and 3				
List-oriented page design: Vol. 2				
Presentation of figures				
Page numbering system				
Headers (area at top of page with page numbers, volume number, current topic, etc.)				

6. Please note by page number or section title any pages or parts, if any, you found difficult to read, visually hard to follow, or problematic in any other way.

E. PRESENTATION MEDIA

1. How would you like to use the CCDH? (check more than one if desired)

___ as a personal tutorial: to read once or twice for knowledge and then pass along
___ as a personal reference work: to keep and look up information as needed over time
___ as a teaching tool for new personnel
___ as a reference work for contractors or other outside personnel involved in improvements to the command center
___ as a tool for developing very specific results, such as a requirements list or room design
___ as a means of communicating needs to superiors
other (please specify) _____

2. How well do you think the CCDH fulfills the need you've indicated above?

___ very well ___ adequately ___ not very well

3. Given the types of information the CCDH contains, which of the following user capabilities do you think it should support?

___ ability to make notes or add information from your own experience on the pages
___ ability to add/replace pages as updates are distributed
___ ability to divide the book into sections and distribute parts to different users
___ ability to devise a customized solution to your particular problem
other (please specify) _____

4. Bearing in mind such issues as ease of use and the need for revisions and updates, what do you think would be the most appropriate way to publish the CCDH information?

___ printed book (as is)
___ CD-ROM disk
___ customized interactive application such as an expert system
___ customized interactive application such as Hypercard stacks
other (please specify) _____

5. If you think just a part of the existing CCDH should be presented in a medium other than a book, or some additional material should be offered in a different medium, briefly describe your idea.

6. Which of the following equipment do you (or the probable users of the CCDH in your organization) have access to? (with respect to computers, "access" includes the ability to store applications or files on equipment)

___ CD-ROM player
___ basic Macintosh workstation (SE or lower model)
___ better Macintosh workstation
___ basic IBM-compatible PC workstation (286)
___ better IBM-compatible PC workstation
___ VHS videocassette player

F. TOPICS TO INVESTIGATE

1. Because DISA's research and technology survey resources are limited, it is important thay they be applied to those areas the command center community considers most important. In particular, suggestions for Demonstration and Technology Survey (DTS) topics are needed. For the technology areas selected, DISA will evaluate all qualified products, present the results of this survey in a Factsheet, sponsor a demonstration, and incorporate the data into "yellow pages" entries in the CCDH. Please note on the back of this page the areas you would like to see investigated. (As an example, the most recent surveys have focused on electronic mapping and optical scanning equipment.)

staple

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Command Center Initiatives Program
Defense Information Systems Agency
Joint Tactical Command, Control and Communications Agency
Virginia Square Plaza
3701 N. Fairfax Dr.
Arlington, VA 22203

Attn: Major Daryl Keppler, Code TVCE

A. OVERALL IMPRESSION

1. What is your overall impression of the usefulness to you of the CCDH in concept, based on the example you've reviewed?

___ very useful
___ somewhat useful
___ possibly useful
___ not very useful
___ not useful at all

2. How would you characterize the technical quality of the CCDH?

___ good
___ overall good, but some bad parts
___ mediocre
___ overall bad, but some good parts
___ bad

3. How would you characterize the readability and ease of use of the handbook?

___ good
___ overall good, but some bad parts
___ mediocre
___ overall bad, but some good parts
___ bad

4. Please focus in on the major parts of the document. For each one, indicate your general impression. Feel free to add comments.

	Liked	Didn't like	No opinion	Didn't review	Comments
Vol. 1:					
Part 1: Command Center Improvement					
Part 2: Command Center Improvement Process					
Part 3: Current Command Center Reference Works					
Part 4: Improvement Process Examples					
Vol. 2:					
Part 1: Introduction					
Part 2: Command Center Core Spaces					
Part 3: Command Center Support Spaces					

Vol. 3:	Liked	Didn't like	No opinion	Didn't review	Comments
Part 1: Introduction					
Part 2: Command Center System Architecture					
Part 3: Communications					
Part 4: Information Processing					
Part 5: Briefing and Display					
Part 6: "Stovepipe" Systems					
Part 7: Facilities					
"Yellow Pages" following Parts 3 and 4					
All Volumes:					
Glossary					
Index					

B. CONTENT

1. How appropriate to your needs was the selection of topics covered in the CCDH (regardless of the data provided for each topic)?

____ very appropriate ____ adequately appropriate ____ not very appropriate

2. In your opinion, was emphasis placed on the right topics? Please note any areas you feel received too much or too little discussion.

____ appropriate emphasis
too much emphasis on _____
too little emphasis on _____

3. How appropriate to your needs was the level of detail presented for each topic?

____ very appropriate ____ adequately appropriate ____ not very appropriate

4. How appropriate was the level of technical knowledge required of the reader?

____ too advanced ____ appropriate ____ too basic

5. Please think over the parts of the CCDH you have reviewed and note if any sections stood out as particularly good or bad in terms of content. You may cite page numbers or sections, and consider the issues raised in questions 1-3 as well as accuracy, completeness, opinion vs. fact, etc.

C. STRUCTURE

1. How well did you feel the CCDH was defined and coordinated as a whole?

___ very well ___ adequately ___ not very well

2. How easily did you develop a sense of the CCDH's structure and an idea of where to find specific information?

___ very easily
___ easily
___ with reasonable effort
___ with significant effort
___ have not yet succeeded in doing so

3. Did any part of the text seem not to fit with the rest of the handbook? Please specify.

4. Did anything appear to be lacking? Please specify.

D. FORMAT/READABILITY

1. How much of the CCDH did you read?

___ a few pages
___ 1/4
___ 1/2
___ most
___ all

2. How did you read the CCDH?

___ looked for and read specific passages only
___ skimmed over it
___ read carefully as much as possible
___ combination of these methods

3. How well did the CCDH support this method of reading?

___ very well ___ adequately ___ not very well

4. With regard to the different page layouts used for different sections, was it clear why a certain layout was used for a particular kind of information?

___ yes ___ sometimes ___ no

5. Did you have any problem adjusting to different page layouts?

___ yes ___ sometimes ___ no

6. Please record your impressions of the format/physical presentation of the CCDH.

	Liked	Didn't like	No opinion	Comments
Type size				
Horizontal orientation				
Narrative page design: Vols. 1 and 3				
List-oriented page design: Vol. 2				
Presentation of figures				
Page numbering system				
Headers (area at top of page with page numbers, volume number, current topic, etc.)				

6. Please note by page number or section title any pages or parts, if any, you found difficult to read, visually hard to follow, or problematic in any other way.

E. PRESENTATION MEDIA

1. How would you like to use the CCDH? (check more than one if desired)

___ as a personal tutorial: to read once or twice for knowledge and then pass along
___ as a personal reference work: to keep and look up information as needed over time
___ as a teaching tool for new personnel
___ as a reference work for contractors or other outside personnel involved in improvements to the command center
___ as a tool for developing very specific results, such as a requirements list or room design
___ as a means of communicating needs to superiors
other (please specify) _____

2. How well do you think the CCDH fulfills the need you've indicated above?

___ very well ___ adequately ___ not very well

3. Given the types of information the CCDH contains, which of the following user capabilities do you think it should support?

___ ability to make notes or add information from your own experience on the pages
___ ability to add/replace pages as updates are distributed
___ ability to divide the book into sections and distribute parts to different users
___ ability to devise a customized solution to your particular problem
other (please specify) _____

4. Bearing in mind such issues as ease of use and the need for revisions and updates, what do you think would be the most appropriate way to publish the CCDH information?

___ printed book (as is)
___ CD-ROM disk
___ customized interactive application such as an expert system
___ customized interactive application such as Hypercard stacks
other (please specify) _____

5. If you think just a part of the existing CCDH should be presented in a medium other than a book, or some additional material should be offered in a *different medium, briefly describe your idea.*

6. Which of the following equipment do you (or the probable users of the CCDH in your organization) have access to? (with respect to computers, "access" includes the ability to store applications or files on equipment)

___ CD-ROM player
___ basic Macintosh workstation (SE or lower model)
___ better Macintosh workstation
___ basic IBM-compatible PC workstation (286)
___ better IBM-compatible PC workstation
___ VHS videocassette player

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